Quincy Mining Company
Houghton County
Hancock
Michigan

HAER No. MI-2

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MICH,
31-HANC,
1-

PHOTOGRAPHS

HISTORICAL DATA

Historic American Engineering Record
National Architectural and Engineering Record
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Washington, D.C. 20243

ADDENDUM TO
QUINCY MINING COMPANY
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HISTORIC AMERICAN ENGINEERING RECORD

Quincy Mining Company
HAER MI-2

Location: The mine proper occupied the hill above Hancock, Michigan on the Keweenaw Peninsula. The first story mill was on the shore of Portage Lake below the mine; the second was on Torch Lake. The smelter was in Ripley, just east of Hancock, on Portage Lake. The main company office, for the most part, was headquartered in New York City.

Dates: Company formed in 1846; incorporated in 1848. Mined the Pewabic Lode continuously from 1856 to 1931, and then again from 1937-1945.

Present Use: Quincy's mine, mill and smelter sites are all inactive.

Significance: Quincy was Michigan's second largest copper producer, and one of national and international importance. The mine was extremely long-lived and profitable.

Historians: Charles K. Hyde, Ph.D.
Larry D. Lankton, Ph.D.
Charles O'Connell
Sarah McNear

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"AN ECONOMIC AND BUSINESS HISTORY OF THE QUINCY MINING COMPANY"

by

Charles K. Hyde

CHAPTER ONE: THE FIRST DECADE

The mine known through most of its history as "Old Reliable" (because of its record of continuous dividends to its stockholders) did not earn this accolade during its early years. An investor who purchased shares in the Quincy Mining Company in November 1846 and was sufficiently patient or foolhardy to hold the stock (few did) enjoyed his first dividend in July 1862. In the interim, the ownership and management of the Company changed four times; operations at the mine were frequently suspended; and more than $300,000 was invested. The first decade was particularly dismal because the mine did not even begin to show promise of future success. Quincy's poor performance was not unusual when placed in the context of early copper mining in Michigan's Upper Peninsula. To contemporaries, the Quincy Mine probably appeared to be just another example of the many speculative ventures that produced financial losses and little copper.

The Context

Douglass Houghton, Michigan's first state geologist, explored the Upper Peninsula in 1840 and 1841. His reports of the existence of copper deposits in the Keewenaw Peninsula created considerable interest in the district.[1] Congress purchased the lands from the Chippewa Indians the following year, making large-scale exploration feasible. The land policy of the Federal government determined the pattern of land exploration and development of the copper lands in the 1840's. Initially, the War Department issued permits enabling the holder to explore an area of nine square miles and subsequently lease it for up to ten years. The area covered by the permits was reduced to one square mile in 1845. Once they began to mine, the leaseholders had to pay a royalty of six per cent on the value of the copper raised during the first three years and then a ten per cent royalty thereafter. This system encouraged a speculative boom in permits, with over one thousand issued, but there was relatively little mining carried out. No new permits were issued after May 1846 and beginning in 1847, the Treasury Department sold the permit lands at $2.50 an acre for an entire section of one square mile (640 acres) or $4.00 an acre for lots as small as forty acres. The price was reduced to $1.25 an acre in September 1850, further encouraging serious long-term investment in the district.[2]

Investing in Michigan copper mines in the 1840s and 1850s was at best highly speculative and extremely risky. The earliest discoveries came at opposite ends of the mineral range--at the tip of the Keweenaw Peninsula and in the vicinity of Ontonagon. The earliest profitable mines, the Cliff and the Minnesota (sic.), were located on fissure veins, where native copper appeared in large pieces or masses.[3] Exploration methods were crude and prospectors used outcroppings or the appearance of native "float" copper left on the surface by glaciation as the measure of a property's potential value. This method was unreliable, since many of the richest veins did not outcrop on the surface and the final resting place of float copper was accidental and bore little relationship to deposits found under the surface.

The risks were also great because it took several years and heavy expenditures to develop a mine to sufficient depth to properly assess its value. Early mine operators had to buy the properties, clear land, erect dwellings, import miners and other workers, construct a surface plant and purchase equipment, and drive several hundred feet of shafts and drifts before taking copper from the ground. Even after a mine began producing copper, it might take several years before revenues covered operating expenses.[4] Even at the immensely profitable Cliff Mine, stockholders spent $110,000 over four years before receiving their first dividend.[5]

Few stockholders were as fortunate as the Cliff's. During the first two decades of speculation in the district, or through 1865, there were ninety-four companies with a total paid-in capital of $13.1 million. Eight of these ventures had returned a total of $5.6 million in dividends to their investors, while the remaining eighty-six, representing investments totaling $11.5 million, paid no dividends. The two most successful fissure mines, the Cliff and the Minnesota, accounted for two-thirds of the total dividends paid out, while three mines in the Portage Lake District (Quincy, Pewabic, and Franklin) which had only begun paying dividends in 1862, accounted for nearly half of the remainder.[6]

Investors naturally tried to minimize their risks. They often bought into a large number of mines, often on adjacent properties, in the hope that at least one might prove to be as rich as the Cliff or Minnesota. Thomas Howe and Edward Hussey, heavy investors in the Cliff, served as Directors of seven other mines in the early 1860s, while Horatio Bigelow, an important Boston capitalist, was the Treasurer of fourteen copper companies in 1854. Thomas F. Mason and T. Henry Perkins, business associates with large holdings of Quincy stock by the early 1860s, were also Directors of at least eight other mining companies in 1865, including the Pewabic and the Franklin companies, with properties close to Quincy lands.[7]

The owners of a mine property could reduce the investment required to develop the mine by allowing others to work it in return for a share of the copper. This "tribute system," a long-standing mining practice in Cornwall, was especially useful in exploring and opening up new works. The tributors bore all the expenses and risks of exploration, but also captured the rewards, usually keeping at least half of the copper.[8] It is not clear how frequently the tribute system was used in the copper district, but it was not an unusual practice.[9]

Foundations

The Quincy Mining Company emerged out of a dispute between two existing ventures, the Portage Mining Company and the Northwestern, of Flint Mining Company. A meeting was held in Marshall, Michigan on November 17, 1846 "for the purpose of organizing a new company based upon the locations late in dispute between the two Companies." Ten stockholders from the Portage Company attended this meeting while James A. Hicks and William A. Howard represented the Northwestern.[10] The precise origin of the dispute is not clear, but it involved conflicting deeds for the same lands.[11]

The participants resolved "that the meeting proceed to organize the new Company without reference to the act of the Legislature of 1846." They issued 3,800 shares of stock, with 500 shares retained by the new company and the remaining 3,300 divided equally between the two parent companies. The meeting then named five Trustees--Eurotas P. Hastings, James A. Hicks, and Charles H. Avery, all from Detroit, as well as two Marshall residents, Ira Nash and Milo Soule, both from the

Portage Company. They selected Hastings as President and Avery as Secretary. They also agreed to twelve "Articles of Association" delineating the duties of the officers, issuance of stock, meetings, etc. The Trustees were empowered to lay an assessment of $1 per share of stock within nine months.[12] The name "Quincy Mining Company" first appeared in the preamble to these articles, but with no explanation as to why it was selected as the corporate name.

There were no drastic changes in the owners or management of the Company between November 1846 and July 1851. James A. Hicks became Treasurer in December 1846 and he replaced Avery as Secretary the following March.[13] There were, however, a few changes among the Directors: Arza C. Robinson of Marshall replaced Ira Nash in December 1847; George F. Macy replaced Charles Avery in July 1848; and Charles M. Giddings then replaced Macy in April 1851.[14] Hastings served as President throughout these years.

The Company's ties with Marshall, however, were weakened because most of the stockholders lived in Detroit. After the initial organizational meeting in Marshall, all subsequent meetings took place in Detroit. Nevertheless, the by-laws adopted on July 26, 1848 specified that two of the Directors reside in Calhoun County and that notices of meetings be carried in a Marshall newspaper.[15] These references to Marshall were finally removed from the by-laws in April 1851.[16] At about the same time, the Directors decided to locate the Company's offices "in the Young Men's building on Jefferson Avenue (in Detroit) in the room now occupied by E. P. Hastings.[17]

There were other more significant developments in the first few years of the Company's existence. It formally acquired the property which would be the foundation of the Company's success--Section 26 in Township 55 North, Range 34 West, located immediately north of the present City of Hancock at the southern end of the Keweenaw Peninsula. At their meeting of March 13, 1848 the stockholders authorized the Trustees to levy an assessment of $1.50 per share of stock to help meet general expenses and "to purchase the Land on which the company are now working."[18] The Quincy Mining Company paid Eurotas P. Hastings the sum of $1,600 for this property on August 7, 1848.[19] The lack of capital and the Company's ambiguous legal status were probably the cause for this delay in buying the land.

The Company was originally established without reference to Michigan's 1846 general law of incorporation.[20] The early stockholders either feared state regulation or simply wished to avoid the expense of getting a special act of incorporation, so for the first two years of its existence, the Quincy Mining Company was not legally a corporation but was simply an "association." However, on April 30, 1848 the Michigan legislature passed "An Act to Incorporate the Quincy Mining Company," authorizing a capital stock of $200,000 divided into 4,000 shares of $50 and granting the Company a corporate life of thirty years. The Act also established a state tax of one per cent on the Company's paid-in capital, loans, and reinvested profits, in lieu of all other state taxes.[21] The Quincy stockholders unanamously accepted the Act at their meeting of July 25, 1848.[22] Two years later, on March 20, 1850 the original act was modified to permit the Company to divide its capital stock into 8,000 shares of $25.[23]

This modification reduced the face value of a share of stock, as well as the potential liability for the owner, from $50 to $25, making the stock more attractive. It was probably motivated by the need to raise additional capital, a chronic problem in these early years. The Directors levied nine assessments on the stock between February 20, 1847 and April 10, 1851, ranging from ten cents to fifty cents per share, for a total of $3.00 per share.[24] With 3,800 shares outstanding, the Company could have theoretically raised $11,400. However, the actual paid-in capital at the beginning of 1851 was only $6,610.[25] For unknown reasons, nearly half of the stock was simply not issued. The earliest list of Quincy stockholders, compiled in September 1848, included only 2,036 shares and no additional shares are shown until September 1850.[26] Apparently many of the stockholders in the two parent companies, who took 3,300 shares in 1846, simply did not pay the early assessments. The narrow appeal of the Quincy stock is evidenced by the fact that ten families owned three-quarters of the stock in 1848.[27]

Stock which remained unsold, as well as shares forfeited for non-payment of assessments, continued to be a major problem for the Company. In August 1849 and again a year later, the Stockholders authorized the Directors to sell all the surplus stock at bargain prices to anyone willing to operate the mine.[28] George W. Hicks took a total of 1,968 shares in September 1850 to bring the total issued to 4,000 shares.[29] However, he paid only fifty cents per share and did not actually pay for the stock until the following March.[30] This shortage of capital was part of a vicious circle that plagued the Company during these years--investors were frightened away because the mine showed little promise, but the shortage of capital made it difficult to explore and develop the property thoroughly.

James A. Hicks probably conducted the first exploration in the hills above Portage Lake during the summer of 1846, under a permit issued by the War Department.[31] Exploration was well underway by October 1846, when there were four men working at the site: Uriah K. Dunn, Superintendent; Edmund

Ingall, cook; George Drake, blacksmith; and Charles Yorke, laborer. They were all employees of the Portage Mining Company and earned a combined total of $85 per month. At their first meeting after the Company was established, the Quincy Directors were presented bills for past expenditures at the mine amounting to $1,242, with two-thirds of thos owed to the Portage Mining Company.[32]

The Company made a second effort to explore the property when they hired Columbus Christopher Douglass in July 1847 "to visit the mines and to report the present condition of same."[33] Douglass was a geologist and engineer with considerable experience in Michigan's copper district.[34] The report of his findings, issued in December, is lost, but there is some evidence suggesting that the mine did not appear very promising.[35] Less than a year later, the Directors seriously considered suspending all operations there.[36]

Virtually all work done at the mine location between October 1846 and March 1851 was directed at locating lodes of copper which could be mined profitably. This exploratory work probably consisted of digging narrow trenches until copper-bearing rock was uncovered and then sinking pits in the most promising formations. The extent and precise location of these workings are unknown, but there is some evidence that the explorations were very limited and largely unsuccessful. The earliest accounts kept by the Company show a small workforce at the mine, probably not much larger than the four men who were there in October 1846. The blacksmith Drake disappeared from the accounts about a year later, while Yorke (laborer) and Ingalls (cook) continued to get paid until January 1849 and July 1850 respectively. It is possible that all of these men remained at the site, but simply do not appear in the accounts. Uriah Dunn, the Superintendent, was paid continuously until March 15, 1851, suggesting that at least some work was carried out over the entire period.[37] It is conceivable that as many as a dozen men may have worked for brief periods, but there is no indication of any sustained effort on even that scale.

The Company's detailed supply accounts of July 1847 show the difficult nature of the early explorations. Half of the twenty-six items delineated were foodstuffs needed for the workers in this isolated region. The other supplies included saws and axes used to clear the land and build log huts or cabins; shovels for trenching; eighty pounds of steel, for drills; two kegs of powder and 500 feet of fuse; and miscellaneous iron and hardwares.[38] The Company probably explored the property continuously, but in a very limited way until March 1851, by which time it had spent nearly $11,000 without finding any productive lodes.[39]

Faced with the prospect of paying additional assessments on their shares, the principal stockholders decided to sell their interest in the Company. The ledgers show major stock transfers on July 4, 1851, when Clement March acquired 1,234 shares, C. C. Douglass 425 shares, and a half dozen others an additional 162 shares.[40] At the stockholders' meeting held in Detroit the next day all of the Directors resigned and were replaced by Solomon Alter, Robert B. Davidson, Joseph C. Herr, Clement March, and Thomas Hale, all from Philadelphia. They selected Alter as President, Hals as Secretary-Treasurer, and moved the Company's principal office to Philadelphia, where it remained until May 1856.[41]

The Philadelphia Period

During the years in Philadelphia, Quincy became a far more serious, less speculative venture with stable management and greater access to capital. The five Directors elected in July served continuously until May 1856. Solomon Alter resigned the Presidency in September 1851, but his successor, Robert Davidson served for nearly five years.[42] The move to Philadelphia, a stable management, and the personal reputations of the Directors combined to encourage new investment. The Company spent a total of more than $30,000 exploring and developing the mine during these five years, but with much the same dismal results as before.

Additional capital was needed if the Company hoped to develop the mine property. They had to borrow $1,000 in September 1851 simply to pay off old debts.[43] A week later, the Directors decided to take advantage of the Act passed by the Michigan legislature in March 1850 authorizing them to increase the number of shares to 8,000 and they gave each stockholder the opportunity to buy the new stock at $1 per share.[44] The shareholders eventually paid a total of nine assessments of fifty cents per share between December 1851 and April 1855.[45] At the beginning of 1852, Davidson reported that the Company had paid-in capital of $7,738, an increase of only $1,128 over the previous year.[46] However, the longer-term results were far more impressive. The Company had paid-in capital of $28,000 by July 1853 and $41,660 in May 1856.[47]

The Ownership of Quincy stock from October 1851 to April 1852 is unclear because the Chesapeake Mining Company had acquired almost all of the Quincy stock to sell to its own shareholders. When the assessment of December 4, 1851 was paid, the Chesapeake owners held 7,200 shares and the funds were transferred directly between the two firms. Clement March owned 4,010 of these, an absolute majority of Quincy's total of 8,000 shares.[48]

At the time of the next assessment in April 1852, the stock was formally in the hands of more than one hundred individuals. March retained a large interest, but stock ownership was more diffuse, although the ten largest owners held 4,206 shares, slightly more than half of the total.[49] There were numerous changes in the individual stockholders during the Philadelphia years, but when the final assessment (April 19, 1855) was paid, ownership was more heavily concentrated in a few hands than before, with the ten largest owners holding 4,914 shares.[50]

Even with this infusion of capital, insufficient operating funds continued to be a major problem. In early 1852 the Company faced a serious financial crisis because it simply did not have enough funds on hand to pay bills. It was unable to pay a draft drawn on Quincy by C. A. Trowbridge of Detroit for $1,254.24, due on February 29th. The problem developed because J. A. Hicks had not paid $215 in assessments due the previous December 4th. A more serious crisis--bankruptcy--was averted when Trowbridge agreed to renew (extend) his draft to give the Company time to raise additional funds with the stock that Hicks had forfeited.[51]

Davidson's correspondence with C. C. Douglass, the Superintendent at the mine, shows the continuing problem of capital shortages. He warned Douglass to give the Treasurer advance warning before drawing funds.[52] Davidson also encouraged Douglass to limit his drafts to $1,000 per month and to pay expenses with drafts drawn at the longest possible date.[53] He constantly emphasized that the Directors wanted to minimize the amount of assessments because the Stockholders were reluctant to pay them.[54]

Non-payment of assessments still plagued the Company, but the problem was less widespread than when Quincy was in Detroit. It was forced to offer 390 shares of forfeited stock at auction in October 1853, but the Company itself bought the shares, probably because the other bids were very low. At a time when the assessments amounted to $3.50 per share, the Company paid an average of only $1,20 for these shares.[55] A Detroit stockholder with 120 shares listed in another party's name had his stock forfeited and argued that he was not notified of the assessment. Davidson was able to get the new owner of the stock to give it up and had it returned to the Detroit man, but warned him: "Should you suffer your Stock to be again forfeited, you cannot expect the Company to extend the same favor to you."[56]

To further complicate matters, a Michigan lawyer named Howard challenged the legal right of companies like Quincy which were chartered in Michigan, but operated in other states, to levy assessments and to confiscate stock for non-payment.[57] Davidson was panic-stricken by this challenge, asked for an emergency meeting of the Directors and ordered Douglass to suspend all operations in Michigan.[58] Howard was evidently mistaken and the crisis passed.

The period when the Company was based in Philadelphia was also a distinct era at the mine, dominated by two pioneers--Columbus Christopher Douglass and his brother-in-law, Ransom Shelden. Douglass had extensive experience in mining before he worked for Quincy. He served as an assistant to Douglass Houghton (his cousin) on a geological expedition in Michigan's Saginaw River Valley in 1837 and then worked with Houghton on a land survey of the Keweenaw Peninsula in 1844.[59] Douglass explored for the Lake Superior Company at Eagle River, but by 1846 was the Agent for the Phoenix Copper Company, a position he lost because he was suspected of stealing silver.[60] He worked briefly for Quincy in 1847, then served as Agent for the Isle Royale Mining Company at Rock Harbor in 1849 and 1850, and by 1851 he was managing the Flint and Fire Steel mines in Ontonagon County as well.[61]

Ransom Shelden was born on a farm in Essex County, New York on July 7, 1814, moved to Wisconsin in 1835 and four years later married the daughter of Christopher Douglass. He moved to Lake Superior in 1846 for health reasons, settled first at L'Anse, where he traded with the Indians, and a year later moved to the entrance of Portage Lake and continued the Indian trade. He was probably the first white settler on Portage Lake. Shelden spent the next few years trading and exploring for copper before accepting a position with Quincy in the fall of 1851, when he moved to a log house somewhere on the side of Quincy Hill.[62] He first appeared in Quincy accounts on July 1, 1849, when he was paid $72.50 for "securing and putting in crops."[63] Shelden was also involved in several other mines and served as the Agent for the Pewabic Mine in 1853-1857, but his greatest success came as a merchant and trader.[64]

Even before Douglass and Shelden took control of operations at the mine in October 1851, the Company began exploring its property more exclusively. The mine apparently sat idle between mid-March and mid-June, when there was only one employee at the location. Seventeen men, including seven miners, were working by the end of July and the workforce grew to twenty-eight by the end of October, with fourteen of these identified as miners. The Company spent nearly $2,300 on wages alone during the last six months of the year.[65] Douglass was optimistic about the prospects of the mine, but Davidson warned him to be cautious in spending the Company's limited resources.[66]

Douglass wrote a total of six letters to Davidson between November 18th and February 17th, creating much optimism about the mine's future.[67] In March the Directors authorized Douglass to increase the workforce to thirty men, presumably in response to his reports.[68] They also moved to retain Douglass permanently. He was apparently serving two masters at this time, because in April 1852, the Quincy Directors offered him a salary of $1,000 per annum provided that the Isle Royale pay him $800 per annum. If he worked exclusively for Quincy, they were willing to give him a salary of $1,500. The final results of this offer are not clear, but Douglass was paid the lower salary in September and October 1852.[70] In any case, Douglass stayed on, increased the workforce from fifteen men in March to thirty in July, and then maintained that employment level for the rest of 1852.[71] The Company spent $4,049 on labor alone in 1852, nearly twice the previous year's expenditures.[72]

We can only speculate on the precise nature and location of the work completed in 1851 and 1852. It seems likely that Douglass had uncovered deposits on the side of Quincy Hill and that this area was the focus of attention. Sam W. Hill's map of the Quincy Mine, dated November 1859, shows four locations which had been worked at a previous, unspecified time. Moving up the hill from Portage Lake, the first location was about 1,800 feet north of the lake (measured horizontally) at an elevation of 150 feet, while the last location was about 3,000 feet from the lake at an elevation of 350 feet.[73] In a letter to Douglass, Davidson suggests the same general location:

> From your letters and diagram I should think it would be well to drift in from the lake on either the Denver or Phila. vein to the intersection of the two and work both from there using the shaft for ventilation. But you must use your own judgement as you are on the spot.[74]

There is considerable evidence that these workings involved more than surface explorations. At one of the locations shown in his 1859 map, Hill noted that copper was "taken from about 10 fathoms."[75] In weekly lists of the workers at the mine in May-July 1852, six men are identified as "miners" and between two and six as "windlass men."[76] Finally, there is a description of the Quincy Mine offered by an unnamed visitor who toured the Portage Lake district in August 1852:

> The Quincy, situated on the north side of the lake, is the only mine in this region, where mining operations are carried out at this time to any extent. Since the enterprising Superintendent, Mr. Douglass, commenced work here last season, a number of acres of the old forest have been turned into pleasant fields, several comfortable buildings have been erected, beside the mine work done. A shaft has been sunk on one of the veins about 100 feet, and they are now cross-cutting to strike some side veins nearby. They have taken out considerable stamp work and some fine pieces of barrel copper and their prospects seem encouraging.[77]

In spite of this growing report, it is not clear how much copper was actually produced. There is no explicit entry for either sales or shipments of copper in any of the firm's surviving records until 1854, when a shipment of 590 pounds of barrel copper was recorded.[78]

The basic organizational structure which developed at the mine during the 1850s remained essentially unchanged through the final closing of Quincy in 1945. Douglass was the Company's chief officer with overall control over operations, reporting directly to the President. However, there was a confusion of titles and functions during the early 1850s, with "Agent" and "Superintendent" inconsistently applied to both Douglass and Shelden. In the ledger accounts, Douglass is consistently called the Superintendent, but in the Time Books kept at the mine, Shelden had that title briefly in 1852, while Douglass had it in 1853-1855.[79] Shelden appeared to be serving as the firm's principal supplier of goods after 1852, while he was the Pewabic Mine Agent. There were two other significant management positions at the mine--the Clerk and the Mining Captain. Charles H. Palmer, who was employed between September 1853 and March 1855, was probably the first Clerk at the Quincy Mine. This position initially carried little power and a low salary, but it later became a more significant post. Palmer, for example, was initially earning only $10 per month, less than one-third the wage of a miner.[80]

The Mining Captain was responsible for directing all work at the mine, both aboveground and underground. He was consistently the second highest paid official at the mine and was second only to the Superintendent in terms of power. The Captain's position and title probably originated in the German mining districts in the fifteenth century, but his traditional duties, power and prestige emerged in the copper and tin mines of Cornwall and were simply transplanted to Michigan.[81] Although Quincy's first Captain, William Worminghaus, who served from June 1853 until March 1855, was probably a German, virtually all of Quincy's later Captains were Cornish.[82]

The early Time Books, probably kept by the Captain, show the structure and organization of the workforce at the mine. In July 1852 there were thirty-three men, including eight miners, six windlass men, eight general surface workers, three carpenters, one teamster, a blacksmith, a "coal burner", and five men whose work was not specified. Ten men, including all the miners and two windlass operators, worked under contract, while the rest were wage laborers.[83]

At Quincy and throughout the Michigan copper district, the vast majority of miners worked under a contract system. Typically, four or six men, often relatives, worked under a contract which was negotiated with the Captain and ran for a month. They were paid a fixed rate per (cubic) fathom of ground excavated, with the rate varying according to the difficulty of the ground worked and the type of working, i.e., shaft-sinking, drifting, cross-cutting, or stoping. These rates were constantly changing from month to month, even for the same group of men doing the same work, suggesting that the Captain adjusted the rates to provide a predetermined monthly income to the miners. Despite appearances, this was not a true piece-rate or "incentive" system, at least not over the long-run. The contractors had to pay for all the supplies they used, such as candles, powder, and fuse, which they usually bought from the Company. The accounts were normally settled at the end of each month and in the net earnings were then divided equally among the contractors. The entire system was a modified version of the tutwork (contract) system in use in Cornwall in the nineteenth century. However, in Cornwall, contracts were normally used only for work done in non-paying ground, while the tribute (profit-sharing) system was used where copper-bearing rock was mined.[84]

Under the contract system, although not necessarily as a result of it, Quincy miners typically earned between two and three times the wages of common laborers during the entire period 1851-1931. These high wages reflected the miners' skills and the hazardous, difficult nature of their work. However, the payments made to this skilled elite must be placed in the broader context of the firm's overall operating expenses. Between July 1851 and June 1855 the Company spent $29,300 at the mine location. They paid contract miners about $7,600 during these years, but wage workers by contrast earned nearly $12,000. The other major expenditures were for supplies ($5,353) and salaries ($4,226).[85]

From the viewpoint of the Philadelphia investors, all of these expenditures were wasted, because the mine simply did not produce enough copper to even suggest any hope of future dividends. They did not come into the venture expecting

Quincy to yield enormous profits instantly. Davidson at least seemed to recognize that Quincy might not become profitable by finding masses of native copper such as those found at the Cliff Mine, but instead might have to rely on the proper "stamp rock" which contained only two or three per cent copper and required extensive processing before it could be sold. In March 1852, he authorized Douglass to buy "a few head of stamps, as many as may be required."[86] A few months later, he expressed the hope that "with judicious working, we should soon have a well-proved and valuable mine, one which will make a dividend before three years."[87] At year's end, Davidson remained quite optimistic, but asked Douglass to send him detailed information on the progress of work at the mine, including maps showing the location of veins, shafts, and cross-cuts. He also wanted estimates of future develop costs: "I wish also to know the prospects of getting a good workable vein and the probable cost of opening it and putting up all the machinery that will be required to make it profitable."[88]

Davidson's letters become increasingly pessimistic as the prospects for earning profits dimmed. He asked Douglass in late November 1853 if there was "any prospect for finding a good paying vein, ..." and cautioned him to minimize expenditures. He noted that silver had been found in some Lake Superior mines and asked Douglass to send some rock samples to Philadelphia for analysis. He added, "we may be able to work the mine profitably for (a) silver vein if no good copper vein should appear."[89]

Davidson seemed ready to give up hope by June 1854, when he first suggested that the principal stockholders wanted to sell the property.[90] It is significant that Douglass, who was in a position to know the mine's real value, was willing to pay only $1.50 per share for Quincy stock, at a time when each share represented $3.50 in paid-in capital.[91] Davidson suspended operations at the mine between mid-July and early October after the challenge to the Company's legal right to levy assessments.[92] He ordered Douglass to resume operations at the end of September, but cautioned, "Unless we can soon get a good vein there seems no use in making further expenditures. Other mines have turned out so badly that we wish great care and economy exercised in regard to this."[93]

Davidson again ordered Douglass to stop all work at the mine in mid-December:

> At a meeting of the managers of the Quincy Mining Company held last week it was decided to stop mining for the present, owing to the extreme tightness in the money market. You will please therefore close up all operations as soon as practicable, and send a statement of accounts to Mr. Hale. Any stock which you may wish to save from forfeiture you will please charge yourself with the assessment due thereon. I send the certificates to have them endorsed. We should like to have a full statement of the condition and prospects of the mines, so that we may be guided by it in future operations. Should there be a favorable change in money matters, we shall probably resume operations. We understand from parties that have visited Portage Lake that the Quincy Mines are some of the most promising in the region. I hope we shall be able to make them profitable as so much has been lost of Lake Superior.[94]

This letter was either lost or Douglass chose not to follow orders, because Davidson was forced to reissue the order to close down two months later and again expressed his desire to sell the entire concern.[95]

The surviving records indicate that the mine did not operate between March 1855 and July 1856. There are no records of contracts executed or wages paid during this period, a significant gap in an otherwise continuous set of records extending from November 1846 to the present. The Quincy Directors fired Douglass in June 1855,[96] appointed William E. Dickinson as Superintendent and instructed him "to stop all the works on our location and settle with the men in such a manner as to retain all the copper on hand for the Company."[97] Total expenditures between March 1855 and June 1856 were only $2,016 and much of this probably consisted of old debts to suppliers and employees.[98] The Company received a bill of exchange for $1,107.76 in February 1856 for sales of copper,[99] but this probably represented work completed much earlier.

Certainly none of the Philadelphia investers who acquired Quincy stock in 1851 and 1852 anticipated these disastrous results. They had sunk $31,313 into the venture between July 1851 and May 1856 and the Company realized a total income from copper sales, net of expenses, of about $1,000.[100] Davidson and the other Directors cannot be faulted for lack of patience. In spite of the absence of any concrete progress at the mine, they kept increasing their rate of spending there until March 1855.[101] To a large extent, they were victimized by bad luck, for the Quincy property contained a fabulously rich copper deposit waiting to be discovered. For a variety of reasons, Douglass had explored and developed the wrong parts of the property.

We cannot establish the precise locations of the workings because Douglass' drawings are lost. Prior to 1854, most of the work was probably done on the side of Quincy Hill above Portage Lake, where some copper was found at or near the surface. The discovery of these small deposits probably encouraged Douglass to dig and then blast exploratory trenches in the general vicinity of the discoveries. These were in fact isolated pockets or poor veins of copper, but that fact was established only after considerable work and expense. Several anonymous reports that appeared in the Mining Magazine described a great deal of activity at the mine in 1853 and 1854, but they did not establish the exact location of the work. The reports were probably based heavily on the information Douglass provided the visitor and seem overly optimistic, particularly when contrasted with the rest of the Company's records. In October 1853, one observer reported:

> This mine is employing a small force, in mining and exploring. The company have lately opened three veins, fron one of which they have taken several lumps or small masses of copper, varying from one to two hundred pounds. The mine looks and promises finely.[102]

In early 1854 Douglass discovered the first extensive vein of copper on the location, sugsequently called the Quincy Lode to distinguish it from the famous Pewabic Lode uncovered a few years later. The Quincy Lode was located on top of Quincy Hill, about 600 feet higher than the elevation of Portage Lake. (See HAER drawing, c. 1865 Map of the Quincy Mine location.) The first reference to the Quincy Lode appears in March 1854, when two miners made a contract "for drifting on the New Vein at the Old Works."[103] At about the same time, the Mining Magazine described a new discovery in glowing terms:

> They have recently at a depth of one hundred feet driven a cross-cut into new ground that is proving very rich in copper. No finer specimens of copper have been found upon the Lake. The Quincy is working a small force, and in an economical and judicious way (is) proving the mine.[104]

The Quincy Lode (or "Vein"--Quincy tended to use the two words interchangeably) was the focus of the development efforts until the mine temporarily closed in March 1855. Douglass was sufficiently encouraged by the initial discoveries to begin sinking two shafts on the vein. Four miners sank a shaft a total of fifty-nine feet between June 3rd and September 3rd.[105] Davidson and the other Quincy Directors were so encouraged by Douglass' reports that they decided to levy another assessment and continue the work. Davidson commented, "We wish you to do it--in the most economical manner to develop the veins; leaving it to your discretion to work the vein you have already found (Quincy Vein) or to trace the other vein by the ancient diggings (?) to our land."[106] Douglass chose to continue on the Quincy Vein and had the shaft extended an additional forty feet between October 27th and February 13th.[107] In the meantime, miners began a second shaft on the same vein on December 22nd and extended it thirty-five feet by February 23rd.[108]

While Douglass pushed the development of the Quincy Vein in the Winter of 1854-1855, the Quincy Directors nevertheless had decided to sell the property. Davidson had prepared for that possibility as early as November 1853, when he asked a Detroit lawyer to perfect the titles to the Quincy property to make a quick sale possible.[109] He then offered to sell the firm to Douglass the following Summer, but with little success.[110] The Directors met on January 22, 1855 and authorized Truman Smith of Connecticut to sell the entire property within a year. Furthermore, if he could find a buyer willing to pay more than $60,000 for it, he could keep the excess for himself.[111] This may have been a legitimate offer to sell, but it certainly was not a realistic one, since the paid-in capital of the Quincy amounted to only $36,000 and the firm's future was hardly promising. A few weeks later, Davidson was cautiously optimistic that they might find a buyer in England.[112]

The Directors' major concerns over the next fifteen months were closing the mine and selling the property. In June they asked Smith to prepare "an exhibit" of the property for a potential (unnamed) European buyer.[113] In January 1856, they extended Smith's authority to sell the property until May 1st to give him additional time to complete negotiations with unnamed London investors who were sufficiently interested to have asked William Bletherick of the Copper Falls Mine to examine the Quincy property for them. Smith needed more time because Bletherick's report to the London parties was lost in transit.[114] This extension brought no results and the Directors decided at their meeting of April 12th to convene a Stockholders' meeting at the Biddle House in Detroit on May 21st to consider selling the property, electing new Directors, and revising the by-laws.[115] The meeting of April 12th marked the end of the Philadelphia years, for the subsequent meeting in Detroit produced a new ownership, management, and corporate headquarters.

The move to Detroit also marked the end of a decade of dismal failure for the Company, in terms of finding copper and generating profits. There is no simple explanation for the failures of the first ten years. There is no evidence, for example, of gross incompetence or dishonesty in the firm's management during these years. The shareholders, at least the principal ones, were not speculators looking for instant profits. Over the ten year period, they sank over $42,000 into Quincy without any return. The firm was certainly undercapitalized during the first decade, particularly before the move to Philadelphia, and perhaps with greater resources they would have discovered the great Pewabic Lode earlier. However, given the overall record of failure among the early Michigan copper companies, it is not surprising that more investment was not forthcoming unless there was a clear prospect for future earnings. This did not happen until Quincy's neighbor, the Pewabic Mining Company, discovered the lode that would become the basis for Quincy's success. Luck played a crucial role in the Company's failures before 1856 and its success thereafter.

NOTES

[1] Houghton simply rediscovered the deposits known to the district's Indian inhabitants for several centuries.

[2] William B. Gates, Jr., Michigan Copper and Boston Dollars: An Economic History of the Michigan Copper Mining Industry (Cambridge, Mass., 1951), pp. 3-6.

[3] Donald Chaput, The Cliff: America's First Great Copper Mine (Kalamazoo, Michigan, 1971) is an excellent study of this important mine.

[4] Gates, Michigan Copper, pp. 33-35.

[5] Chaput, Cliff, pp. 22, 36.

[6] C. Harry Benedict, Red Metal: The Calumet and Hecla Story (Ann Arbor, 1952), pp. 8-10.

[7] Gates, Michigan Copper, pp. 34-35.

[8] Cornish tribute practices are discussed at length in A. K. Hamilton Jenkin, The Cornish Miner (London, 1927), pp. 134-138.

[9] Tributors worked the Calumet Mine in 1866, the Franklin and Pewabic Mines in 1870-1874, and the Quincy in the early 1850s. See Benedict, Red Metal, pp. 46-47; Gates, Michigan Copper, pp. 40-41; and pp. below for details.

[10] QMC, Directors' Minutes, 17 November 1846.

[11] At a subsequent meeting on December 15, 1846, the Portage Mining Company transferred deeds for "locations No. 477, 478, and 479," (to the Quincy) and the Northwestern transferred deeds for "locations No. 315, 477, and 479." The Mineral Agency at Copper Harbor produced a map of the land claims and a list of lease-holders, both reproduced in John R. St. John, A True Description of the Lake

NOTES

Superior Country (New York, 1846), pp. 101-102. However, the map and list only multiply the confusion. The lease for Location Number 478 was held by Barth. Bank, while Location Number 315 does not appear on the map, although Ed. Moran is identified as the leaseholder in the list. St. John recognized that these were unreliable sources. He noted that none of the permits issued in 1843 (a total of 113) were included in the list, although they appeared on the map. He added, "But no real certainty of correctness between the list and the map can be depended upon, for public books and official business I never saw in such conglomerate state as those of this Mineral Agency."

[12]QMC, Directors' Minutes, 17 November 1846. The five "Trustees" became "Directors" in July 1848.

[13]Ibid., Directors' Meetings of 15 December 1846 and 1 March 1847.

[14]Ibid., 6 December 1847, 25 July, 1848, and 10 April 1851.

[15]Ibid., 26 July 1848, By-laws 3 and 4.

[16]Ibid., 10 April 1851.

[17]Ibid., 1 March 1851.

[18]Ibid., 13 March 1848.

[19]QMC, New York Journal, 1847-1851, p. 19.

[20]State of Michigan, Acts of the Legislature, Revised Statutes of 1846, Chapter 55, Title 10.

[21]Ibid., 1848, p. 185.

[22]QMC, Directors' Minutes, Stockholders' Meeting of 25 July 1848.

[23]State of Michigan, Acts of the Legislature, 1850, p. 90.

NOTES

[24]The dates the assessments were due and the amounts: 20 February 1847 (50¢); 20 August 1847 (40¢); 20 November 1847 (10¢); 1 May 1848 (25¢); 1 June 1848 (25¢); 1 July 1848 (50¢); 1 January 1849 (50¢); 1 March 1851 (25¢); and 10 April 1851 (25¢).

[25]State of Michigan, Commerce Department, Corporation Annual Reports, J. W. Hicks to the Auditor General of the State of Michigan, 1 January 1851.

[26]QMC, Stock Journal, 1848-1851.

[27]The largest stockholders and the shares they held: James A. and George W. Hicks (305); Robert A. Howard (259); Samuel A. Hastings (212); Henry A. and Zenas Tillotson (147); Alvin Turner (100); Robert Williamson (100); Bartholomew Banks (100); Ara Cook (75); Macy F. Driggs (80); and Arza C. Robinson (50).

[28]QMC, Directors' Minutes, Stockholders' Meetings of 25 August 1849 and 6 August 1850.

[29]QMC, Stock Journal, 1848-1851, entries for 1 September 1850.

[30]QMC, New York Journal, 1847-1851, p. 26.

[31]Dr. James Fischer, "Historical Sketch of the Lake Superior Copper District," in the Keweenawan (Houghton, 1924), p. 254.

[32]QMC, Directors' Minutes, Directors' Meeting of 15 December 1846.

[33]Ibid., 9 July 1847.

[34]Douglass' career will be discussed in detail later in this chapter.

[35]QMC, Directors' Minutes, Stockholders' Meeting of 6 December 1847.

[36]Ibid., Directors' Meeting of 9 October 1848.

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[37]QMC, New York Journal, 1847-1851, passim.

[38]Ibid., entries for 13 and 27 July 1847.

[39]According to the accounts kept at the mine location, total expenditures through June 1851 amounted to $10,884, suggesting that the Company was heavily in debt at the time. The Company's paid-in capital was only $6,610 in January 1851. Even if the two assessments of March and April 1851 (25 cents each) were fully subscribed on all 4,000 shares, the Company still would have been about $2,000 in debt by June 1851.

[40]QMC, Stock Journal, 1848-1851, pp. 7-9.

[41]QMC, Directors' Minutes, Stockholders' Meeting of 5 July 1851.

[42]Ibid., Directors' Meeting of 17 September 1851.

[43]Ibid.

[44]Ibid., 23 September 1851.

[45]The assessments were due on 4 December 1851, 15 April 1852, 1 June 1852, 6 August 1852, 12 February 1853, 26 October 1853, 15 April 1854, and 19 April 1855.

[46]State of Michigan, Commerce Department, Corporation Annual Reports, Robert B. Davidson to the Treasurer of the State of Michigan, 1 January 1852.

[47]Ibid., 1 January 1853 and QMC, New York Journal, 1857-1872, p. 2. By May 1856 there were 8,000 shares with a total of $5.50 assessed per share, so the paid-in capital should have amounted to $44,000.

[48]QMC, New York Ledger, 1851-1856, p. 1 and New York Journal, 1851-1856, pp. 2-3.

[49]QMC, New York Ledger, 1851-1856, p. 25 and New York Cashbook, 1852-1856, pp. 1-3. The ten largest stockholders and the number of shares held: the Alter family (1068); Clement March (755); the Hicks family (600); W. A. Howard (410); C. C. Douglass (340); E. Clark (250); J. W. Allen (225); C. A. Trowbridge (200); J. Smith (200); and Robert B. Davidson (158).

[50]QMC, New York Ledger, 1851-1856, p. 36 and New York Cashbook, 1852-1856, pp. 13, 14. The ten largest stockholders and the number of shares held: Clement March (1502); T. Walter (630); C. C. Douglass (602); W. E. Dickinson (570); Q. A. Shaw (400); the Hicks family (400); E. Clark, Jr. (250); F. N. Buck (200); J. Smith (200); and J. B. Palmer (160).

[51]Robert B. Davidson to C. A. Trowbridge, 30 January and 17 February 1852.

[52]Davidson to C. C. Douglass, 15 November 1851.

[53]Ibid., 24 June 1852.

[54]Ibid., 24 June 1852, 30 November 1852, and 7 June 1854.

[55]QMC, Directors' Minutes, Directors' Meeting of 25 October 1853.

[56]Davidson to Andrew T. McReynolds, 20 April 1854.

[57]Davidson to Clement March, 3 July 1854.

[58]Ibid., and Davidson to C. C. Douglass, 8 July 1854.

[59]Bela Hubbard, "A Michigan Geological Expedition in 1837," Michigan Pioneer Collections, III (1879-1880), pp. 189-190 and John H. Forster, "Early Settlement of the Copper Regions of Lake Superior," Michigan Pioneer Collections, VII (1886), pp. 183-184.

[60]Marquette Weekly Mining Journal, 27 July 1872, p. 1 and Western Historical Company, History of the Upper Peninsula of Michigan (Chicago, 1883), p. 334.

[61]James Russell, First Annual Review of the Copper Mining Industry of Lake Superior (Marquette, Michigan, 1899), p. 31.

[62]Alvah Sawyer, History of the Northern Peninsula of Michigan (Chicago, 1911), I, p. 480; Alfred P. Swineford, History and Review of the Mineral Resources of the South Shore of Lake Superior (Marquette, Michigan 1877), p. 53; and Western Historical Company, History, p. 286.

[63]QMC, New York Journal, 1847-1851, p. 23. He is listed as "R. Sheldon."

[64]Pewabic Mining Company, Annual Report for 1862, p. 6 and Western Historical Company, History, p. 286.

[65]QMC, Time Book, 1851-1855, n.p.

[66]Davidson to Douglass, 15 November 1851.

[67]Ibid., 16 March 1852 refers to "encouraging" letters of 18 and 29 November 1851, 8 and 27 December 1851, and 16 and 17 February 1852.

[68]QMC, Directors' Minutes, Directors' Meeting of 13 March 1852.

[69]Ibid. 29 April 1852.

[70]QMC, Day Book 1852-1856, p. 28.

[71]QMC, Time Book, 1851-1855, n.p.

[72]Ibid.

[73]S. W. Hill, "Longitudinal Section of the Quincy Mine, Nov. 1859."

[74]Davidson to Douglass, 16 March 1852.

[75]S. W. Hill, "Longitudinal Section."

[76]QMC, Time Book, 1851-1855, n.p.

[77]Lake Superior Journal (Sault Ste. Marie, Michigan), III, No. 12, 4 August 1852, p. 2.

[78]QMC, Contract Book, 1854-1856, n.p.

[79]QMC, Time 8ook, 1851-1855, n.p.

[80]Ibid.

[81]Jenkin, Cornish Miner, pp. 49, 78-79, 230.

[82]Worminghaus was not explicitly called "Captain" until November 1854, but he first appeared in the Time Book in June 1853 and from the beginning earned a substantially larger salary than anyone else at the mine with the exception of Douglass. He earned about $36 a month in June 1853 compared to $29 for the next highest paid individual and a year later his monthly salary was $58 compared to $33 a month for the next highest paid employee.

[83]QMC, Time 8ook, 1851-1855, n.p.

[84]Jenkin, Cornish Miner, pp. 139, 204, 227.

[85]QMC, Ledger, 1851-1856, pp. 109, 112.

[86]Davidson to Douglass, 16 March 1852.

[87]Ibid., 24 June 1852.

[88]lbid., 22 December 1852.

[89]Ibid., 30 November 1853. In a later latter of 22 March 1854, Davidson reveals that the samples were sent to Philadelphia and analyzed, but contained no silver.

[90]Davidson to Douglass, 7 June 1854.

[91]Davidson to Clement March, 3 July 1854.

[92]Davidson to Douglass, 8 July 1854 and previous discussion in this chapter. This stoppage is confirmed by the Time Book for 1851-1855.

[93]Davidson to Douglass, 28 September 1854.

[94]Ibid., 19 December, 1854.

[95]Ibid., 12 February 1855.

[96]QMC, Directors' Minutes, Directors' Meeting of 11 June 1855.

[97]Ibid., 3 July 1855.

[98]QMC, Ledger, 1851-1856, pp. 109, 112, 115-136.

[99]QMC, New York Journal, 1851, 1856, p. 12.

[100]Total expenditures at the mine, as reconstructed from the Ledger for 1851-1856, were distributed as follows:

July-December 1851	$2,274 (labor only)
1852	4,049 (labor only)
1853	5,921
1854	6,593
January-March 1855	2,352
April 1855-May 1856	2,016
TOTAL	$23,205

The total cost of the Philadelphia operations of the Company, including officers' salaries, came to $5,313, leaving $2,795 not accounted for. It is likely that most of this was spent at the mine in 1851 and 1852, but was not clearly delineated in the accounts.

[102]Mining Magazine, I, 4 (October 1853), p. 416.

[103]QMC, Contract Book, 1854-1855, entry for 22 March 1854.

[104]Mining Magazine, II, 4 (April 1854), p. 430.

[105]QMC, Contract Book, 1854-1855, entries for 24 July and 4 September 1854.

[106] Davidson to Douglass, 28 September 1854.

[107] QMC, Contract Book, 1854-1855, entry for 13 February 1855.

[108] *Ibid.*, entry for 24 February 1855.

[109] Davidson to David Stuart, 22 November 1853.

[110] Davidson to Douglass, 7 June and 8 July 1854.

[111] QMC, Directors' Minutes, Directors' Meeting of 22 January 1855.

[112] Davidson to Clement March, 12 February 1855.

[113] QMC, Directors' Minutes, Directors' Meeting of July 1855.

[114] *Ibid.*, 29 January 1856.

[115] *Ibid.*, 12 April 1856.

CHAPTER TWO: GROWING PAINS

Quincy's fortunes improved considerably in 1856 with the discovery of the Pewabic Lode and a simultaneous change in management. The Company's stockholders agreed to pay an additional $156,000 in assessments and to reinvest another $150,000 of earnings into the mine before they received their first dividend in July 1862 because the discoveries made at the mine location in the late 1850s were very promising. The Company spent about $300,000 in 1856-1861 for underground development work, an extensive surface plant, and workers' housing. Although copper production and profits were considerable during the decade beginning in 1862, this was also a period of great economic instability, producing sudden changes in Quincy's circumstances and creating great uncertainty about its future. The Civil War produced severe disruptions in the markets for copper, labor, and raw materials, and in the postwar years the Lake Superior copper mines passed through a difficult period of adjustment because of a severely depressed copper market. Quincy not only survived this period of great change and earned profits during these years, but by the early 1870s, the Company had developed into a far more efficient operation, in terms of its technology and its organizational structure.

The Pewabic Lode and the First Profits

The Stockholders' meeting held in Detroit in May 21, 1856 was an important turning point in the Company's history. The stock was in the hands of new investors who elected a new Board of Directors - S. S. Barnard, Thomas F. Mason, Horatio Bigelow, Henry N. Walker, and C. C. Douglass.[1] The new Directors elected Barnard, President; E. W. Wilcox, Treasurer; and W. L. Whipple, Secretary. All three were Detroit residents and the Company's office was moved to that city. The Directors also withdrew the previous Board's authorization to sell the property and appointed C. C. Douglass Superintendent of the mine, thus indicating their intention to revive mining operations.[2]

The Company headquarters remained in Detroit for less than two years. At the Directors' meeting of October 8, 1857 it was proposed that the office be moved to New York City "in view of the probable necessity of seeking advances and the greater facility of effecting the same in New York."[3] The final decision was made a month later, at which time Directors Duffield and Wilcox resigned and were replaced by William Hickok and John Simpkins, both from New York.[4] At the next meeting, held in New York on January 6, 1858, Thomas F. Mason was elected President, while Barnard continued to serve as a Director.[5] Mason's election reflected his position as the Quincy's largest stockholder.[6] From that point forward, the ownership and management of the Quincy was predominantly in the hands of Eastern investors, mostly from New York and Boston. One Michigan resident, often the Company's Agent, always served as a Director, thus meeting a legal requirement stipulated by the Company's Michigan charter.

Beginning in late 1856 the Quincy Directors levied a series of assessments on stock which raised a total of $156,000 between October 1856 and February 1860.[7] They proceeded slowly, raising $8,000 in 1856 and $24,000 in 1857. They then expanded the capital stock from 8,000 to 20,000 shares of $10 each in late 1857 in order to reach the Company's authorized capitalization of $200,000.[8] Four assessments between March 1858 and February 1860 produced an additional $124,000. These assessments were needed because of the high cost of developing the mine and were forthcoming from the stockholders because of the great progress achieved there.

Development efforts at the mine location were pushed in several directions in the year and a half after the new management took control in May 1856. C. C. Douglass was permitted to resume developing the Quincy Lode, abandoned in March 1855. The two existing shafts were extended and a third one begun. The first was extended seventy-five feet between November 1856 and January 1858, reaching a depth of 174 feet; the second shaft received the most attention and between July 1856 and August 1858 was sunk an additional 174 feet to a depth of 210 feet; the third shaft, begun in October 1857, reached a depth of 113 feet by August 1858.[9] The Company contracted with John Whiting and Charles Martin to erect three shaft houses on the Quincy Vein in November 1856, agreeing to pay them $45.00 per shaft house.[10] These structures probably held hand-powered windlasses, and beginning in 1857 the Company contracted with teams of three to six men "to hoist all the rock and water" from one or more shafts on the lode.[11] The Quincy Lode was worked extensively until the end of September 1858, when the last contract expired. The Contract Book for this period includes scores of contracts covering shaft sinking, winze sinking, exploration (drifting and cross-cuts), stoping, and hoisting.[12]

Work on the Quincy Lode was entirely suspended by October 1858 and from that time forward the Company concentrated almost exclusively on developing the Pewabic Lode, initially discovered by the Pewabic Mining Company in 1855.[13] This change in strategy came only a few months after C. C. Douglass resigned as Agent in June and was replaced by Samuel Worth Hill.[14] The precise reason for abandoning the Quincy Lode is not clear, nor do the accounts reveal how much copper was found there. The small output (less than seven tons) which the Company sold in 1856 was probably all from the Quincy Lode, but the next year, when sales amounted to sixty-one tons, both Lodes contributed to the total.[15] It is possible that the Quincy Lode still showed considerable copper when it was abandoned, but simply did not seem as promising as the rich Pewabic Lode nearby.

Work on the Pewabic Lode probably began in late 1856 or early 1857, utilizing tributors who dug trenches along the surface to locat the copper and then sunk test pits at the most promising locations. There was an extensive, if not exclusive reliance on tributors to develop the works through 1857.[16] There was so much copper discovered that between October 1857 and March 1858 the Company quickly sank three shafts on one portion of the vein about 600 feet long. One observer reported in March 1858 that three shafts operated and that a forty-ton mass of copper had been discovered between shafts Number Two and Three.[17] He noted that the lode "is very productive in places and has yielded a number of tons of copper, but it does not come up to the Pewabic mine in richness."[18] Furthermore, he claimed that the pits on the Pewabic Lode north of the three shafts showed ten times more copper than the area being worked and he criticized the Quincy management for not developing that portion of the property more fully.[19]

Through early 1860 the Company attempted to explore the mine location thoroughly before ultimately deciding to concentrate its efforts on the northern portion of the property. The Pewabic Lode extended southwesterly from the Pewabic Mining Company boundary a total of 5,800 feet on Quincy lands. According to the 1861 Annual Report, the Company spent $11,500

"For Openings and Exploration on 3,800 feet 'East' of Pewabic Vein, extending to Portage Lake, preparatory to future workings."[20] Much of this exploratory work was done in 1859, when there were a series of contracts for exploring, earth excavation, sinking of pits and shafts, cross-cutting, and stoping.[21] Maps produced by Samuel W. Hill in November 1859 show three "open cuts in vein," the first about 1,000 feet southwest of Quincy's Number Six Shaft. The second open cut was 600 feet southwest of the first and the third one another 300 hundred feet further down the side of Quincy Hill.[22] They were initially encouraged by the discovery of five tons of copper at one of these cuts and nearly one ton at another, but it is not certain how much copper was ultimately found.[23] The cross-cuts apparently did not show enough copper to encourage further development, and by early 1860 the Company was concentrating its efforts on the northernmost 2,000 feet of the lode.

The Company also explored and developed the Hancock Vein, located about 700 feet west of the Pewabic Vein and running parallel to it. There were a series of contracts issued between June 1859 and September 1860 for exploration, shaft sinking, and drifting, all performed by Quincy workers, but charged to the Hancock Mining Company.[24] By late 1859 they had already opened three shafts and an adit on the Hancock Vein.[25] They apparently explored this area to prove the existence of copper deposits there, so that they could sell the property (the S. W. ¼ of Section 26, T. 55, R. 34) to the Hancock Mining Company. They did this on June 21, 1859, but with the provision that Quincy retain the mineral rights to the Pewabic Lode if it should appear on this property.[26]

While the Company was completing these explorations, further development of the northernmost third of the Pewabic Lode proceeded quickly. The numbering of the first three shafts was altered in January 1859, so that they were identified as Shafts Number Two, Three, and Four.[27] Three additional shafts were begun in less than a year's time: Number Five in December 1858; Number One in July 1859; and Number Six in August 1859.[28] By November 1859 there were six shafts sunk, the deepest extending 170 feet, with the first five linked by drifts at the Second Level (120 feet).[29] Further underground development of the mine for the most part entailed extending these six shafts, driving additional drifts between them at each succeeding level of sixty feet, and stoping out the copper-bearing rock.

The exploration and developmental work, as well as the increased mining that followed, called for a dramatic expansion in the workforce. In 1857 and for the first none months of 1858, between 80 and 120 men worked at the mine location, with peak employment during the warmer months. Beginning in the fall of 1858 the labor force grew rapidly, but as the data in Table 2.1 indicate, there was no direct relationship between employment and copper production during these years. The figures reflect

TABLE 2.1: TOTAL EMPLOYMENT AT THE QUINCY MINE (IN JUNE) AND SALES OF COPPER (TONS), 1856-1861

	Employment	Sales
1856	?	6.7
1857	115	61.4
1858	119	153
1859	257	179
1860	469	970
1861	583	1,282

SOURCE: QMC, Returns of Labor, 1857-1864 and Annual Report For 1861, pp. 6, 7.

the development process, where the proportion of the labor force working on exploration and development might vary greatly from year to year. A shifting emphasis on development versus mining can be seen from the changing proportions of contract miners engaged in development work (sinking, drifting, and cross-cutting), summarized in Table 2.2. Production could rise dramatically in 1858 and 1860 without proportionate increases in the workforce because manpower had been concentrated on development work in 1857 and 1859.

TABLE 2.2: CONTRACT MINERS AT THE QUINCY MINE, ACCORDING TO TYPE OF CONTRACT (IN JUNE), 1859-1862

	Number of Miners	Development Work	Stoping	Development Work As Share of Total (%)
1859	157	110	47	70
1860	132	83	49	63
1861	112	47	65	42
1862	127	89	38	70

SOURCE: QMC, Contract Book, 1857-1860, 1860-1863.

The Company made an enormous capital investment in the mine in 1857-1861, principally in machinery, surface buildings, transportation facilities, and housing. The total investment during these years approached $300,000.[30] Nearly $50,000 was spent on machinery of various types, but most of the remainder was sunk into buildings and civil engineering works, principally in 1859-1861. An inventory taken in March 1859 shows a relatively small physical plant, much of it built to serve the Quincy Lode workings, and valued at only $12,585 altogether.[31] There were three houses for mine officials, four boarding houses, and twenty-seven log houses, for a total of $7,440 in housing alone.[32] The Company essentially built an entirely new surface plant, with all the necessary machinery and equipment in a three-year period.

The first major investment was the development of the mine itself. The Company explicitly recognized development costs of $11,500, but most of the underground development work was simply treated as "Mining Costs" in the accounts. The total invested in development work was probably at least $30,000.[33]

Installing a hoisting system, including engines, engine houses, shaft houses, pulley stands, kibbles, and chains was the next major requirement. In early 1862 the Company valued these buildings, machinery and equipment at about $26,000, which understated their original cost.[34] They also constructed a variety of other surface buildings including a blacksmith shop, carpenter shop, dry house, powder house, and office building. In addition, they built an elevated tramway linking the shaft houses to the kilnhouses and then running several hundred feet to the head (beginning) of the Quincy Tramroad, which in turn ran down the side of Quincy Hill to the Quincy Mill on Portage Lake, a distance of 3,500 feet. The tramroad and stamp mill were built in 1859 and went into service in March 1860.[35] The Company paid the contractors Ralston & Lapp almost $5,500 for constructing the tramroad, not including the cost of the track, tramcars, or drum house.[36] The costs of building and equipping the stamp mill are not known, but almost certainly represented the largest single investment the Company made during these years. In 1861 alone, they invested an additional $14,000 just to upgrade the stamp mill.[37]

Because of the mine's isolated location, the Company had to invest heavily in "infrastructure" which would normally be in place in an established industrial community. They constructed housing, roads, docks, and warehouses, and established a Company-operated farm. These items may have accounted for up to a third of the total Quincy investments of 1857-1861. Housing was the most important part of these expenditures, but cannot be documented in very previse terms. The Company owned 34 dwellings in March 1859, including two "old" boardinghouses and twenty-seven log houses.[38] At the end of 1862, they owned 136 "Tenements," ten of which were built in that year.[39] Since several of the 1859 dwellings probably did not survive through 1862, particularly some of the log houses, the Company built about one hundred dwellings in 1859-1861. These ranged from log houses which cost about $150 each to the elaborate mine officials' residences costing more than $1,000 each. It is perhaps reasonable to estimate a total investment in housing of at least $30,000 during this period.

In cooperation with the other Portage Lake mines, Quincy also invested in the transportation system linking Hancock with the lower Great Lakes. The completion of a canal and locks around the St. Mary's Rapids at Sault Ste. Marie in June 1855 had removed the most important bottleneck to Great Lakes navigation.[40] The second bottleneck was the Portage River, linking Portage Lake to Lake Superior. It was a narrow, winding waterway about five miles long and too shallow to accommodate most of the lake carriers. They had to anchor at the entrance to the river and unload their cargoes onto smaller boats for shipment to the wharves on Portage Lake. At the urging of Shelden and Douglass, the mining companies in the Portage Lake district spent $30,000 widening and dredging the river beginning in 1859, and by June 1860 the first large ship was able to dock at Hancock.[41] They continued to work on this water route, for in 1861 Quincy recorded expenditures of $1,543 for "Entry Improvement."[42] The next year the mining companies established the Portage River Improvement Company, which charged tolls for the use of the channel and used the receipts to maintain and improve it.[43] In 1865, Quincy's share of the stock of this company was $10,600.[44]

Quincy's experiences in 1856-1861 illustrate the difficulty and expense of developing a copper mine to the point where it began to pay dividends. The Company's overall performance during these years is summarized in Table 2.3 below.

TABLE 2.3: QUINCY MINING COMPANY GROSS EXPENDITURES AND REVENUES, 1856-1861

Period	Mining Expenses	Total Expenses	Sales of Copper	Surplus(+) or Deficit(-)
June 1856-1 March 1858	$ 52,721	$ 73,216	$ 25,900	$ -47,316
Year Ending 1 March 1859	100,395	123,106	70,271	-52,835
" " 1 March 1860	166,177	222,038	78,959	-143,079
" " 1 March 1861	231,459	314,012	233,467	-80,545
March 1-Dec. 31, 1861	236,528	329,047	377,358	+48,311

SOURCES: QMC, Ledger, 1856-1859, pp. 1, 255, 365, 562; QMC Annual Report for 1861, pp. 6, 7; QMC Directors' Minutes, 1856-1878, p. 101.

These figures require some explanation. The staggering "losses" between June 1856 and March 1861, amounting to $323,775, are not losses in the usual sense, but represent the difference between total expenditures and revenues, which in the case of the Quincy, indicates the amount invested in the property during these years. Because most of the development work and construction of permanent improvements were counted as "Mining Costs" before 1861, the overall figures are misleading. The revenues realized from copper sales were probably covering the immediate short-run costs of getting that copper mined and sent to market, but were totally inadequate to pay for the massive investment required to fully develop and equip the mine.

The Company would not have been willing or able to undergo this brief period of massive deficit spending without the clearcut prospects for future profits that the Pewabic Lode offered. Assessments on stock totalling $157,852 made up half of the total deficit and the remainder was financed through borrowing. As of August 1, 1861 the Company had $108,700 in outstanding loans.[45] The precise source and nature of Quincy's loans are not entirely clear, but the accounts show substantial interest payments during these years.[46] By the second half of 1861, the Company had finally passed a critical juncture, where its revenues from the sale of copper were sufficient to cover all expenditures including investments at the mine. This trend continued into the following year and on July 31, 1862, the Quincy Mining Company paid its first dividend, $3 per share.[47]

Civil War and Postwar Trials

During the Civil War the Michigan copper producers were subjected to a new set of economic pressures which on balance discouraged the orderly, rational development of the industry. Quincy faced the same difficulties as other producers, but coped with the new situation reasonably well. The most noticeable impact of the war was an increase in demand for copper and a drastic rise in copper prices, which to a great extent simply reflected the rapid general inflation of these years. Copper prices jumped from 19 cents (per pound) in 1861 to 46 cents in 1864.[48] The price increases had perverse results, leading to a decrease in copper production for the entire district. Michigan's 1861 output of 7,519 tons was not surpassed until 1868 and the year of highest copper prices (1864) saw the lowest output level (6,245 tons) of the entire decade.[49] The war effort, including the draft, drained some men from the district, but more importantly, the high copper prices encouraged the speculative development of dozens of new mines, which drained experienced labor from the established mines. The result was a profound district-wide shortage of labor, particularly a serious shortage of experienced miners. Consequently, wage rates skyrocketed, there was a greater turnover of workers, and productivity fell.[50]

Quincy's operations were not greatly affected by this labor shortage until the fall of 1862. The monthly wages paid to miners averaged $41.23 for 1862, down slightly from the previous year.[51] The mine's production fell in 1862, but this simply reflected a heavier concentration on developmental work (Table 2.2). Correspondence between the Company Agent, S. S. Robinson and Mason indicated a tightening labor market in the second half of 1862. Robinson suggested as early as August that the draft might cause serious problems and that the copper producers should consider requesting a district-wide exemption.[52] He revealed in late September that he was trying to recruit fifty men in Canada to bolster the mine's labor force.[53] They were also trying to recruit experienced miners in Europe. Robinson advised that they concentrate more efforts on central and northern Europe and less on Cornwall, noting that the Cornish miners did not want to settle permanently in the United States and were sending most of their earnings back to relatives in Cornwall. They were demanding enormous wages because the American Dollar was falling on foreign exchange markets, so a Cornishman needed more Dollars to buy a given amount of English currency.[54] He was also deeply concerned about recruiting single men in general:

> Miners coming here and bringing their families and settling will avoid that source of trouble. All the surroundings and circumstances of a floating and roving population tend to extravagance and high prices and high wages, while the tendency of a fixed population is the reverse.[55]

The labor shortage became more serious in 1863 and then worsened for the duration of the war. Robinson complained that a shortage of labor was driving up production costs and suggested that all the mines in the district "should at once decide either to do less work or provide more men."[56] In 1863 contract wages had risen about fifteen percent from the previous year, but had jumped sharply in the closing months of the year.[57] Average monthly wages for contract miners reached $65.45 in 1864 and fell only slightly to $57.52 in 1865.[58] Since the labor shortage was a district-wide problem, the mining companies attempted several cooperative solutions. They continually pressed, without success, to have the district exempted from the draft.[59] More importantly, they launched a major effort to import foreign workers.

The Company's expenditures on labor recruitment became substantial in the last years of the war. It had already spent $3,121 in 1863 and the Directors had agreed to advance up to $15,000 as Quincy's share of a cooperative effort "for the purpose of bringing over from Norway and Sweden a hardy and industrious class of miners and laborers, which it is hoped will be successful, and form a nucleus for the gradual introduction of a permanent population sufficient to develop the resources of the country.[60] In 1864 the Company spent $19,427 on labor recruitment and contributed an additional $2,076 to the Houghton County Draft Exemption Fund.[61] Two labor recruiters who were probably shared by several copper companies appear regularly in the Quincy accounts in 1864. Allen MacIntyre secured men in Canada, while Axel Silversparre recruited in Sweden.[62] The companies advanced the cost of passage to the recruits, who in turn signed contracts to work for the company and to repay the loans. Collectively, the Michigan mining companies spent about $100,000 on these recruiting efforts, with mixed results.[63]

A major problem plaguing the entire recruiting campaign was the inability of the mining companies to control these recruits once they arrived in the United States. In one incident, a boat carrying about one hundred and fifty Swedish immigrants stopped briefly in Detroit on its way to Hancock during the Summer of 1864. An Army recruiter boarded the ship in Detroit and before it reached Hancock, he had convinced thirty of the men to join the Union Army and thus collect a $300 bonus. The Swedes also conveniently forgot to repay the passage money advanced by the mining companies. Later, Silversparre was accused of filling his quota of Swedes by convincing the Swedish government to release men serving long sentences in Swedish prisons.[64] It is not clear how many workers the Company actually gained as a result of these efforts.

The accounts indicate that they paid for the passage of eighty-five men, mostly Swedes, in June-September 1864 and for an additional thirty-two French-Canadians in November.[65] The Company had built a separate settlement, "Swedetown" to house these new immigrants and there were some Swedes living there a year later, but it is not clear how many actually worked for the Company.[66] Overall, the recruiting effort was a costly fiasco. In their report for 1864, the Directors noted:

> The difficulties of controlling and regulating our working force, arising from the scarcity and consequent high prices of labor, which have affected our operations in the past, still continue. The efforts made by the leading companies on Portage Lake, during the last season, to increase the supply, by introducing a foreign population, have met with only partial success.[67]

The Company spent an additional $1,778 on labor recruitment in 1865, probably as a result of previous obligations.[68]

There were also serious shortages of supplies, including food, which further disrupted the mines' normal operations. In 1862 the Quincy Directors purchased the surface rights to Sections 15 and 22 adjoining the mine as a hedge against rising timber and cordwood prices, paying $17,446 for the property.[69] All of the mines in the district found gunpowder in short supply in late 1863 and seven companies dispatched S. S. Robinson to look for powder that could be delivered before the close of the shipping season. Writing from Detroit, Robinson informed Quincy's Mine Clerk that although he had been authorized to buy 5,725 kegs for the mines, he had actually purchased 5,928 kegs. He notified the Clerk that Quincy would take the extra powder "from the cheapest lot."[70] Even the installation of new equipment was made more expensive or put off altogether because of the difficulties in securing machinery and parts.[71]

Finally, the Company was forced to import food and other necessities for its employees beginning in 1864 as a result of food shortages and rapidly escalating prices. They established a company store in October and reported that "the measure has so far worked well, enabling the employees to live cheaper without loss to the Company, and thus making our working force less fluctuating and more reliable."[72]

The Civil War era was generally a period of severe economic and social dislocation for the entire copper district. Shortages of food and other materials, tremendous price instability, a rapid turnover of the labor force, and the introduction of various immigrant groups into the isolated frontier society produced an explosive situation. J. H. Forster, who was the Agent at the Pewabic and Franklin mines in 1861-1862 reported that "law and order" nearly broke down entirely during the Winter of 1861-1862. There were severe shortages of currency and the mines were forced to issue their own script. Food was scarce, but whiskey was not. There was excessive drinking and considerable lawlessness by gangs of armed men, particularly Cornish and Irish workers. They committed numerous beatings and murders, looted stores, and at one point threatened to burn down the Pewabic Stamp Mill.[73] The law abiding citizens (property owners) were sufficiently frightened by this experience to convince the State to send them fifty mustkets before the next winter began.[74] This arsenal was kept in the basement of the Quincy Mine office building. In the Spring of 1864 the Company built a drill hall at the brow of the Quincy Hill and established a voluntary militia company, which included about 150 men and an instructor provided by the State.[75]

With the end of the war, the demand for copper declined and prices fell off sharply. The average price received by the Company fell from 47 cents in 1864 to 23 cents by 1868 and 21 cents in 1870.[76] As prices fell quickly at the end of the war, the Company suffered a major loss because of its inability to get copper to market during the winter months. When copper (in the form of mineral concentrate) held in Hancock at the end of the 1864 shipping season was finally sold in the Spring of 1865, its value had declined by $44,000.[77] However, the longer-range impact of declining demand was far more important. Production fell from 1,360 tons in 1865 to a low of 708 tons in 1868, and then stabilized at roughly 1,200 tons in 1869-1871.[78] Wages declined as well, but more slowly than copper prices, putting additional pressure on profits. Between 1864 and 1868, for example, copper prices fell fifty percent, while wages paid to contract miners fell only twenty-two percent.[79] The Company's relatively poor performance in the late 1860s, which will be considered in more detail later in this chapter, was largely the result of this combination of rapidly falling prices and "sticky" wages. All of the Michigan producers shared in this crisis, which was exacerbated by the opening of the Calument and Helca mines in 1867.[80] Quincy joined the other mining companies in several collective efforts to improve their position.

They attempted to develop a common front against their employees, to give the mine owners more leverage in reducing wages or resisting demands for increases. On March 5, 1869 seven Agents representing ten Houghton County mines met at the Quincy Mine office and established the Houghton County Mine Agents Union.[81] The object of the organization was to "promote unity and harmony of action in the management of the various mining interests of the County and for the mutual protection of its members and the advancement of the interests of the companies they represent."[82] They met only five times and all their resolutions dealt with strikes among their workers. They agreed to inform all the member Agents when there was a strike underway at any of the mines. More significantly, they also agreed that they would stop hiring new employees for the duration of any strike at any of the mines represented.[83] It is not clear how significant or effective this group was, for there is no evidence of any serious strikes at Quincy or elsewhere in the district until 1872. The formation of this anti-labor "Union" at least reveals the willingness of the mining companies to cooperate on matters of common interest.

The Michigan copper producers also cooperated in agitating for increased tariff protection against foreign imports. The tariff enacted in 1861 provided for duties of two cents per pound on imports of refined copper and a five percent ad valorum duty on copper ores.[84] The sharp declines in prices at the end of the war touched off renewed agitation for increased protection beginning in 1865.[85] There was a new tariff bill introduced in Congress in 1866, but it was not approved.[86] After additional lobbying efforts, which included considerable support from the smaller California and Tennessee copper districts, a new protective tariff was approved in February 1869 and passed over President Johnson's veto. It increased the duty on refined copper from two cents to five cents per pound (the domestic price was 24 cents in 1869) and raised the duties on copper ores and manufactured copper as well. The immediate impact of the bill was to kill the East Coast smelting industry, which had relied on foreign ores.[87] Over the longer run it helped produce higher domestic copper prices because it operated in conjunction with a copper producers' price pool which will be considered in depth in the next chapter.

None of these efforts to bolster copper prices had any impact until the 1870s. The Company's response to the postwar depression was to sharply reduce output, employment, and investment in the mine. The workforce was reduced from a peak of about 650 in 1864-1865 to a total of 350 in 1868.[88] The changing pattern of investment is shown in Table 2.4 below. The investment in "Housing"

TABLE 2.4: INVESTMENT IN "PERMANENT IMPROVEMENTS" AT THE QUINCY MINE, 1862-1871

	Total Investment	Investment In Housing	Average Investment Per Annum
1862-1865	$ 132,074	$ 63,777	$ 33,018
1866-1871	64,189	1,900	10,698

SOURCE: QMC, <u>Journals</u>, 1861-1863, 1857-1866, 1867-1871, <u>passim</u>.

accounted for nearly half of the total in 1862-1865 and was heavily concentrated in 1864 and 1865, when the Company spent $57,300 to build 112 houses, two boarding houses, a school and a hospital.[89]

Housing construction virtually ceased after 1865 and most of the investments made in 1866-1871 pertained to improvements absolutely essential for the mine's continued operation. As the mine went deeper, the Company was forced to build a man-engine to transport men up and down.[90] The installation of this device in 1866 and subsequent extensions cost a total of $20,668 in 1866-1871.[91] An unavoidable reconstruction of the Tram Road in 1868 cost an additional $11,820.[92] The construction of a new engine house at the Number Two Shaft in 1867-1868 cost $9,700 and the installation of new boilers and a new drum at the Number Four shaft cost an additional

$7,807 in 1868-1871.[93] These four major projects, none of which could have been postponed, account for $50,000 of the $64,189 invested in 1866-1871. The Company was generally cautious and conservative about spending during these difficult postwar years.

There was, however, one significant and in some respects curious exception to this pattern of cautious spending--the Side Hill Adit fiasco. During the years 1864-1868 the Company spent a total of $68,554 exploring the southern end of the property, with dismal results.[94] In the 1864 report to the Quincy Stockholders, the Company Directors explained the origin of this effort:

> Besides the Pewabic Vein, on which the mine is opened, many other veins are known to exist upon the Company's property, and your Directors have long been desirous of ascertaining their value. To this end, a system of explorations was organized early in the summer, and, after a number of surface openings, it was decided to drive an adit across the formation, which would cut and thoroughly prove all the lodes, and be available to work economically any that should prove to be productive. This adit is now in progress, and promises the most satisfactory results.[95]

They began in June by exploring an area eighteen hundred feet south of the part of the Pewabic Lode already developed, essentially reexamining the exploratory shafts that Sam Hill had abandoned in 1858. They worked there several months before concluding that the ground was worthless and then moved about one thousand feet back up the Hill toward the Company's existing workings. They proceeded to sink several exploratory shafts, after first revealing the underlying veins with several open cuts on the side of the Hill. After some promising finds, but some difficulties in working at the surface level, they decided to drive an adit northwesterly from a point east of the Tram Road, at a level sixty feet under the tracks. This adit ran perpendicular to a series of veins which were located southeast of the Pewabic Lode and ran parallel to it, thus in a northwesterly direction.[96]

This work was expanded considerably in 1865, when the Company spent $35,435 in the effort.[97] In the Annual Report for that year, George Hardie, the Company Agent, reported several promising discoveries along the Side-Hill Adit and staunchly defended these expenditures:

> To have abandoned these works, when the indications attending them were so full of promise, would be to lose, as dead work, a great portion of the labor and expense of the previous year, and to set aside all of the advantages which it confidently expected would accrue to the Company as a result of this expenditure. Such a policy would have been contrary to all well-established customs and suicidal to the real interests of legitimate mining.[98]

Hardie was so defensive about this project that he must have been one of the chief advocates of the effort, which was apparently meeting with considerable opposition from stockholders. There was, however, a more ominous and threatening note in the Directors' general report to the stockholders, probably written by Mason. This report suggested that the Company had no choice but to pursue the Side-Hill Adit because they had "lost" the Pewabic Lode at the southern end of the existing workings.[99] The report nevertheless ended on an extremely optimistic note:

> But in the vicinity of this new adit, the ground seems settled and the strike regular, and it is hoped that through it the Pewabic Lode will be discovered in its proper place and character. If it is so found, the adit will afford the means of opening and working a large amount of ground, without expensive machinery, as it brings out the broken rock at a convenient place for removal to the stamps, and is so large and straight that horses can readily work in it.[100]

It had become clear by 1866 that the Side-Hill Adit was not going to uncover any workable copper deposits, although it had been extended a total of 925 feet. Hardie recommended that the adit be driven as far as the Pewabic Lode, but that no other work be attempted.[101] It was extended another 185 feet in 1867 at a total cost of $3,014.[102] The Side-Hill Adit was driven another seventy-seven feet in early 1868, but work was entirely suspended on June 1st, after the Company had expended another $1,414.[103] These expenditures on explorations which ultimately produced no significant discoveries need to be assessed within the overall context of the Company's operations. The investment of over $68,000 on this work was nearly half the amount the Company spent on all other "permanent improvements" in 1864-1868. From the standpoint of the Quincy stockholders and with the benefit of hindsight, these expenditures were an unnecessary waste of the Company's resources. However, given the serious problems the Quincy was having in locating the Pewabic Lode, Mason and Hardie were acting vigorously and responsibly in pushing the Side-Hill Adit explorations.

Given all the difficulties the Company faced during the period 1862-1871, it was still able to earn profits each year, even during the postwar years when prices fell disastrously. The figures presented in Table 2.5 show the difficulties of the postwar years, especially 1866-1868. Given the low prices of copper in 1869-1871, the Company's performance was a strong one. They were producing roughly the same output as in 1864 with one-third fewer employees and with a negligible investment in the mine property. In fact, once the general price deflation and particularly the fall of share prices are taken into account, the Company's profits and dividends were larger (in real terms) in 1869-1871 than in 1864. An investor who may have paid $25 for a share of Quincy stock in 1870 received dividends of $6, compared to dividends of $14 paid in 1864 on a share that cost $100.

The Company was able to regain its earlier profitability because it became a more efficient producer during the 1860s. There is no clearcut explanation for this improvement in terms of the technology in use, because it did not change significantly during these years. The improved efficiency came instead from numerous small improvements in most phases of the Company's operations, from underground development work to the final sale of the copper. In effect, a young inexperienced producer learned dozens of small lessons, admittedly under severe economic pressures, and emerged by the early 1870s with a smaller but more experienced labor force and management.

It is difficult to trace movements in production costs during this period because the variables influencing costs were changing drastically from year to year. To pare down the number of variables that need to be examined, the Company's performance is examined here over two years which have some important similarities--1862 and 1870. Both were years of prosperity, with similar market prices for copper, which makes cost comparisons more meaningful. More importantly, in both years the richness of the copper-bearing rock taken from the mine was virtually the same (Table 2.6), thus removing from the comparison the element of

TABLE 2.6: QUINCY MINE ROCK QUALITY, 1862, 1870

	Tons of Rock Stamped	Mineral Produced (Tons)	Mineral as a Share of Rock Treated (% by Weight)	Ingot Copper as a Share of Mineral (% by Weight)	Ingot Copper Per Ton of Rock Treated (Pounds)
1862	42,633	1,252	2.9	84.8	49
1870	55,027	1,523	2.8	84.6	47

SOURCE: QMC, Annual Reports, 1862, 1870.

uncontrollable change in the richness of the Pewabic Vein in any particular year, which is not a reflection of the efficiency of the Company's operations.

TABLE 2.5: QUINCY MINING COMPANY, INDICATORS OF AGGREGATE PERFORMANCE, 1862-1871

	Total Employment	Sales of Copper (Tons)	Average Sale Price (Cents Per Pound)	Gross Profits	Permanent Investment & Exploration	Net Profits	Dividends	Stock Quotations High	Stock Quotations Low
1862	588	1,153	22	$234,069	$21,629	$212,440	$140,000	$ 64	$34
1863	620	1,113	34	382,096	14,194	367,902	240,000	98	62
1864	646	1,248	47	468,305	88,654	379,651	320,000	112	87
1865	654	1,063	39	126,873	58,367	68,506	--	100	47
1866	598	1,057	34	86,407	36,133	50,274	--	70	37
1867	370	961	25	76,744	14,059	62,685	60,000	38	15
1868	346	709	23	48,419	18,435	29,984	40,000	34	15
1869	429	1,209	24	134,534	5,847	128,687	120,000	37	18
1870	422	1,248	21	161,671	4,041	157,630	80,000	32	17
1871	440	1,205	24	197,835	3,458	194,377	260,000	34	20

SOURCE: QMC, Annual Reports, 1862-1871 and Lawton, Review, p. 28.

These figures at least suggest that they were taking roughly the same quality of rock from the mine and that the stamp mill was producing similar results in both years. Prior to 1862, there had been enormous improvements in the Mineral Yield (percentage yield by weight of ingot copper from mineral), probably reflecting more selective mining and stamp mill efficiency.[104] In 1862-1871, the Mineral Yield fluctuated between a low of 80.2 percent in 1871 to a high of 84.8 percent in 1862.[105]

Assuming then that the two years are comparable in these ways, the Company's overall cost performance, summarized in Table 2.7, was impressive. In spite of the decline in copper prices, the

TABLE 2.7: QUINCY MINING COMPANY, OVERALL COSTS, 1862, 1870

	Mineral Produced (Tons)	Ignot Copper Output (Tons)	Total Work-Force	Total Operating Costs, Excluding Permanent Improvements	Operating Costs Per Pound of Ingot Copper (Cents)	Average Selling Price (Cents)
1862	1,253	1,062	588	$ 374,189	17.6	21.8
1870	1,523	1,279	422	378,668	14.8	21.1

SOURCES: QMC, Annual Reports, 1862, 1870. The figures for Ingot Copper Output treat the mineral produced in these years as if it were all smelted within the calendar year. This was never the case because of the interrupted shipping season on Lake Superior.

Company widened the margin between operating costs and revenues over the period. They increased copper production 20 percent, while simultaneously reducing the workforce by 28 percent, so that the copper produced per employee rose by an impressive 67 percent. These aggregate figures reveal little about the sources of these cost reductions, which can be uncovered by breaking down the mine's operations into its major component parts.

The Company's accounts permit us to distinguish between four major categories of expenditures, summarized in Table 2.8.[106] Mining Costs include all underground expenses for mining and tramming, as well as all the costs of getting the rock to the surface. Surface Costs include the expenses of sorting, breaking and calcining (burning) the rock, transporting it down the Tram Road to the Stamp Mill, and "General Surface Expenses," which include the wages or salaries of all surface workers, including company officials. Stamping costs include all running costs incurred there. The final category, "Other Costs," includes smelting and marketing costs, taxes, interest, insurance, transportation, and all the expenses of the New York office.

A closer examination of each of these broad areas of expenditure reveals the major sources of cost changes. Mining Costs were the largest single expense and at the same time are the most problematical so they will be examined last. The savings in Surface Costs were significant in absolute terms and the largest in percentage terms as well. The cost of "Assorting, Breaking, and Calcining Rock" was roughly the same in both years, one cent per pound of ingot copper produced. The costs of moving rock on the Tram Road fell substantially as a result of its reconstruction in 1868, from 20 cents per ton of rock moved in 1862 to 13 cents in 1870. However, these savings account for only one-fifth of the total reduction of Surface Costs. The rest took place in the ill-defined area of "General Surface Expenses," which includes miscellaneous surface labor, supplies, and mine officials' salaries. The precise nature of these cost reductions is ambiguous.

Stamping costs increased during these years both in absolute terms and as a share of total costs. A detailed breakdown of these costs (Table 2.9) shows that the major problem during these years was the rapidly escalating

TABLE 2.8: QUINCY MINING COMPANY COSTS, BY MAJOR ACTIVITY, 1862, 1870

		Mining	Surface	Stamping	"Other"	Total
1862:	Total Costs	$ 202,425	$ 62,385	$ 47,528	$ 61,851	$ 374,189
	Share of Total (%)	54	17	13	16	100
	Cost Per Pound of Ingot Copper (Cents)	9.5	2.9	2.2	2.9	17.6
1870:	Total Costs	$ 202,260	$ 47,601	$ 63,679	$ 65,128	$ 378,668
	Share of Total (%)	53	13	17	17	100
	Cost Per Pound of Ingot Copper (Cents)	7.9	1.9	2.4	2.6	14.8

TABLE 2.9: QUINCY STAMP MILL COSTS, 1862, 1870

	Tons of Rock Treated	Total Costs	Total Costs Per Ton of Rock Treated	Total Repair Costs	Labor Costs, Excluding Labor on Repairs	Oil, Wood, Tallow & Lighting Costs
1862	42,633	$47,528	$1.02	$14,263	$21,998	$11,367
1870	55,027	63,679	1.16	14,011	29,524	20,144

costs of raw materials, principally cordwood for the boilers and lubricants like oil and tallow. Taking into account the increase in the tonnage of rock stamped, labor costs remained constant and there were substantial savings in repair costs, but these were more than wiped out by rising raw materials costs. Here, cordwood was the key. The amount of cordwood used for each ton of rock stamped was virtually the same in both years, but the average price paid per cord jumped from $2.52 in 1862 to $3.47 in 1870. The total bill for cordwood jumped from $9,667 to $17,364 as a result.

The category, "Other Costs," summarized in Table 2.10 is dominated by the expenses the Company incurred to have the mineral transported to the smelter in Detroit, the cost of smelting, and the costs of marketing the ingot, mainly commissions, which they label "Copper Charges." These three expenses account for 8% of the total in both years. The cost of running the New York office ($4,788

TABLE 2.10: QUINCY MINING COMPANY, "OTHER COSTS," 1862, 1870

	Ingot Copper Output (Tons)	Total "Other" Costs	Transportation and Insurance	Smelting	"Copper Charges"
1862	1,062	$61,851	$18,850	$23,816	$11,148
1870	1,279	65,128	19,027	26,525	10,887

in 1862) was minor by comparison. The Company was able to reduce these costs relative to the volume of copper produced, but it is not clear that congratulations are in order. The Company may have simply enjoyed the benefits of improved efficiency on the part of shippers, smelters, and sales agents who were then forced by competition to reduce their rates. There is little direct evidence that the Company's management was more skilled at negotiating with these suppliers of services than any other mine's management. Quincy, for example, was paying the same smelting charges as her two neighbors, the Pewabic and Franklin mines during these years.[107]

The success of the Company ultimately depended on the efficiency of its underground operations. Between 1862 and 1870, the Company achieved significant reductions in Mining Costs, in spite of increased wages paid to the miners. The overall performance, summarized in Table 2.11, deserves to be scrutinized in more detail. Several points of clarification are in order. First, the payments made to contract miners accounted for about two-thirds of Mining Costs in both years and half of the remaining costs were also incurred underground, mainly in the form of wages to underground laborers and non-contract miners. The later, usually called "Miners on Company Account," made up between five and ten percent of the miners during the 1860s.[108] These men may have had the difficult job of cutting up pieces of mass copper underground, where normal contract rates would be irrevelant. Their work is not clearly delineated in the accounts.

TABLE 2.11: QUINCY MINING COMPANY, MINING COSTS, 1862, 1870

	Ingot Copper Output (Tons)	Total Mining Costs	Mining Costs Per Pound of Ingot Copper (Cents)	Contract Miners	Monthly Wages, Contract Miners	Ingot Copper Per Miner (Tons)
1862	1,062	$202,425	9.5	220	$41.23	4.83
1870	1,278	202,620	7.9	181	46.00	7.11
% Change	20	nil	-17	-18	12	47

The most impressive gain, which more than counterbalanced the increased wages, was the amount of ignot copper realized per miner. This gain was not the result of discovering richer ground, but was partly due to a heavier concentration on stoping in 1870. To be sure, shaft-sinking and drifting produced some copper, but were nevertheless unproductive compared to stoping. The shift in expenditures and in the work performed can be seen in Table 2.12 below. The proportion of spending on stoping rose from 59% in 1862 to 66% in 1870. This shift, however, can account for only a small part of the total gain in ingot production per miner. This is particularly the case if the proportion of miners on Company Account who stoped did not change radically during these years.

TABLE 2.12: UNDERGROUND MINING, BY TYPE AND COST

	Shaft-Sinking		Winze-Sinking		Drifting and Crosscutting		Stoping	
	Feet	Cost	Feet	Cost	Feet	Cost	Fathoms	Cost
1862	494	$ 9,979	722	$ 9,530	2,626	$29,384	4,048	$72,338
1870	354	11,325	272	4,462	1,740	23,446	4,275	76,766

The curious development was that while only 6% more ground was stoped out, copper production increased by 20%. Since the richness of the rock reaching the Stamp Mill did not change, there are only two likely explanations for this apparent anomoly. It is possible that more copper rock was recovered from sinking and drifting, particularly the later. This would have been the case if drifting proceeded more systematically, that is, directly through more "paying" ground. Perhaps this explains why the cost of drifting rose between these years, while the cost of soping did not. This seems an unlikely explanation, since the absolute amount of sinking and drifting fell substantially between 1862 and 1870.

We need to concentrate on stoping performed by contract miners. They stoped out 6% more ground, but also realized 14% more ingot copper per fathom stoped. Since the rock sent to the Stamp Mill did not change, they must have achieved this result by stoping out less "poor rock," i.e., rock containing no copper, which would normally be discarded underground or during the initial sorting process at the surface.[109] It is significant that while the total volume of rock excavated in the two years was roughly the same because the increased stoping was offset by the decreased sinking and drifting, the tonnage of rock sent to the Stamp Mill rose 13% in 1862-1870. In any case, of the total increase in copper production, two-thirds came from more careful stoping and one-third from the increase in ground stoped.

The Company received 14% more copper per fathom stoped, but paid virtually the same price for each fathom in both years. Stoping costs per pound of ingot copper fell from 3.4 cents to 3.0 cents, accounting for one-fourth of the total savings in Mining Costs. This was achieved in spite of a rise in miners' wages because each miner stoped out more ground in 1870 than in 1862. If the miners doing stope work were receiving the average wage paid to all contract miners in both 1862 and 1870, then the average miner would have stoped out about 28 fathoms in 1862, but nearly 31 fathoms in 1870, a gain of roughly 11%.

These improvements in physical productivity are summarized in Table 2.13 below. First it should be recalled that of the increase in copper output of

TABLE 2.13: PHYSICAL PRODUCTIVITY AT THE QUINCY MINE, 1862, 1870

	Ingot Copper Output (Tons)	Ingot Copper Per Miner (Tons)	Ingot Copper Per Stoper (Tons)	Amount Stoped (Fathoms)	Ingot Copper Per Fathom Stoped (Pounds)	Fathoms Stoped Per Stoper	Miners	Stopers
1862	1,062	4.83	7.27	4,048	524	27.68	220	146
1870	1,279	7.11	9.13	4,275	598	30.73	181	140
% Change	20	47	25	6	14	11	-18	-4

20%, less than one-third (6%) can be attributed to the increased amount of stoping and more than two-thirds (14%) to the greater yield of copper per fathom stoped. About half of the 47% increase in ingot copper production per miner (25%) came from the increased productivity of each stoper, while the remaining half (22%) must be attributed to the shift away from development work toward more stoping. Furthermore, the 25% improvement in stopers' productivity was divided between the 14% increase in copper per fathom stoped and the 11% increase in the amount of stoping each man did. Because of this improvement in the physical productivity of stopers, the Company could reduce stoping costs substantially in spite of paying the miners 12% more in 1870 than in 1862.

Since there was no striking technological breakthrough in underground mining methods in the 1860s how do we account for the 11% increase in ground stoped per man? Perhaps the fact that as a whole, the miners of 1870 were more experienced than earlier may be a sufficient explanation. In fact, there may have been no real improvement in the productivity of stopers in terms of ground stoped per hour spent working. Stopers simply spent about ten percent more time stoping per shift than they had earlier, without any increase in the length of the workday. The completion of the Man Engine in 1866 probably saved the men at least one full hour per shift getting to and from the workings. It was not an accident that the average number of fathoms stoped per man per year jumped from about 28 in 1865 to 31 in 1867 and then remained at the higher level for the rest of the decade.[110] In this case at least, we can credit a single improvement in technology for an important reduction in costs.

This reduction in stoping costs accounted for only one quarter of the total reduction in Mining Costs. Half of the savings, or 0.8 cents per pound of ignot copper, came from reducing the spending on sinking and drifting relative to output (from 2.3 to 1.5 cents per pound of ingot copper) in spite of the increase in rates paid per foot sunk or drifted. As Table 2.12 above shows, there was a drastic reduction in winze-sinking and a cut of about one-third in shaft-sinking and drifting. It is not clear whether these cuts reflect a more judicious, systematic development of the minr or a less wise, perhaps dangerous decision to forgo needed development work for the sake of propping up profits in the short run. The rest of the savings in Mining Costs came from reducing the costs of tramming, hoisting, and supplies, but the available accounts do not provide sufficient detail to identify the particular sources of savings.

The Company survived the difficult 1860s because it reduced its costs of production by becoming more efficient in several phases of its overall operations. Perhaps a third of the efficiency improvements can be linked with technological changes which were embodied in new machinery and equipment, like the improved tram road, the man-engine, and skips. To fully understand the gains of the 1860s, we must broaden our definition of technology to include production and organizational techniques which are not embodied in hardware, for these seem to account for most of the efficiency gains achieved by the Company. Knowledge about production methods gets embodied or embedded in the minds of the workers drilling rock, pushing tramcars, handling rock at the surface, running stamps, or conducting maintenance work throughout the production system. Techniques improve as these workers learn through experience, acquiring thousands of separate bits of information about mining, moving, and processing copper rock. The people managing production went through a similar learning process during the 1860s. One of the reasons for Quincy's relative success during these years was an overall improvement in the way in which the Company was organized and managed. This facet of the Company's development deserves a more detailed analysis.

Organization and Operation in the 1860s

The formal organization of the Quincy Mining Company was relatively simple. Legally and at least in theory, ultimate authority over the Company's operations rested with the Stockholders. They routinely met once a year, usually in March, and elected Directors, typically by ratifying a single slate of candidates. The Directors in turn met immediately after the Stockholders Meeting and elected the Company President. When one of their members resigned, the remaining Directors would appoint a replacement. Executive authority rested with the Directors, but since they typically met only once a month, they naturally delegated the authority to make routine decisions to the President. He in turn ran the New York office directly and supervised the mine operations through extensive correspondence with the Company's Agent in Hancock. In addition, the President usually made at least one lengthy visit per year to the mine location. During the period 1858-1899, with a brief interruption in 1872-1875, Thomas Fales Mason was the President of the Company. His personality shaped the office so profoundly that it is difficult to separate the two.

As is the case in most modern corporations, the management and ownership of the Quincy became increasingly separated over time. This divergence was partly the result of a growing diffusion of stock ownership. In March 1858 the ten largest Quincy stockholders owned two-thirds of the shares, but ten years later, the ten largest stockholders held only one quarter of the total, while the twenty largest owners controlled 38% of the shares. In February 1868 the Directors held only six percent of the 20,000 shares outstanding. Mason, who had owned 1,428 shares in February 1865, held only 470 shares by February 1868.[111] In addition, there was a growing geographical separation of ownership from management because the Quincy stock was increasingly owned by Boston investors, while the Company offices remained in New York City. When a dividend was paid in February 1865, New York investors held 55% of the shares and Boston investors the rest, but when the next dividend was distributed in February 1868, Bostonians held 69% of the Quincy stock.[112] Recognizing this shift, the Quincy Directors agreed in March 1867 to establish a (stock) Transfer Office in Boston under the control of T. Henry Perkins, a Director, with the proviso that it cost no more than $500 a year. However, they voted to terminate this experiment a year later. This decision contributed to the growing friction between the New York and Boston stockholders which resulted in Mason's temporary ouster in 1872 and the removal of the Company's office to Boston at the same time. This episode will be considered in detail in the next chapter.

The New York office was a small but extremely powerful part of the Company's operating structure.[113] In addition to the President, there was a full-time Secretary and Treasurer based there and typically these two positions were held by one person. In 1863, Mason was paid a salary of $5,000, while the Secretary-Treasurer earned $2,000.[114] The total running expenses of the office, <u>excluding</u> these salaries, was only $4,553 in 1863.[115] The New York Office became the focal point of power within the Company because it served as the intermediary between the mine and the market, as well as between the management and the stockholders. The physical separation between the center of production and sales, and between the stockholders and the mine, meant that only the chief officials at the New York office could adequately understand the entire operation. Information flowed through the New York office, often giving the New York officials a monopoly on knowledge of the Company's affairs and therefore enormous power.

It is not an accident that all of the Quincy Presidents after Mason had worked in responsible positions in the New York office. The Secretary-Treasurer became the second most powerful official within the Company. John Simpkins, who was also a major stockholder, held this position from January 1858 until June 1862, when he was replaced by W. Hart Smith, who became a lifelong business associate of Mason. Smith served as Secretary-Treasurer until March 1869 and then continued as Treasurer until March 1872, when the Boston interests ousted Mason. The new Secretary in 1869 was William Rogers Todd, who then served as Secretary-Treasurer in 1873-1902 and as President of the Company in 1902-1924. Todd's connection with the Company went back at least to January 1860, when he first appeared in the accounts working as the Assistant Mine Clerk at the mine location, at a salary of $50 per month.[116] He remained there until early 1863, when he moved to the New York office, presumably to work as Smith's assistant.[117] His career will be considered in more detail later in this study.

One of the major tasks coordinated from New York was the smelting of the mineral produced by the Company's Stamp Mill. Until the late 1880s, all of the Michigan copper companies contracted with outside firms that operated a handful of smelters. It was not economically feasible for each individual mine to operate its own smelter when outputs were still relatively small. Besides, smelting was a complex process requiring considerable experience and technical expertise which the typical producer could not afford to acquire during the early decades of the district's growth. When the Michigan deposits were first developed in the 1840s, there were only a handful of small smelters in operation on the East Coast, primarily in Boston and Baltimore. There were a couple of unsuccessful attempts to erect smelters in the copper district in the 1840s, but in the 1850s, virtually all of the district's mineral was smelted in Detroit, Cleveland, and Pittsburgh. The largest smelter was built in Detroit in 1850 by the Waterbury and Detroit Copper Company, founded and managed by John R. Grout. Grout had convinced four large brass manufacturers in Waterbury, Connecticut to supply the capital for this venture and thus assure themselves of a dependable supply of high quality copper. In 1860 the Portage Lake Smelting Company opened a plant in Hancock, on the shores of Portage Lake. The two firms merged in 1867 to form the Detroit and Lake Superior Copper Company, which by the early 1880s had a near-monopoly on the smelting of Michigan copper.[118]

The Quincy management had few options in selecting a smelter even during the relatively competitive years before 1867. They began sending all of their mineral to the Waterbury and Detroit plant in Detroit at least as early as January 1857 and continued this arrangement without interruption until 1872, when they began to split their mineral between the Hancock and Detroit plants of the Detroit and Lake Superior Smelting Company.[119] The temporary competition provided by the Portage Lake Smelting Works in 1860-1867 produced a significant reduction in smelting charges, which fell from $17 per ton of mineral in the late 1850s to $15 per ton by 1866.[120] In order to keep both of its plants operating, the Detroit and Lake Superior Company engaged in rate discrimination in the 1870s, charging $17 a ton for mineral smelted in Hancock and $15 for mineral sent to the Detroit works.[121]

The way in which the product of the mine was handled after leaving the Stamp Mill created several important problems for the Quincy and the other Michigan producers. They retained ownership of the mineral and the ingot copper until it was sold in Eastern markets, primarily in New York. Eight or nine months might elapse between the time the Company paid its employees for work done at the mine location and the time the Company received cash for the product of that work.[122] Part of the delay was the result of granting short-term credit, usually four months, to buyers of copper, but much of it resulted from the producers' almost total dependence on the Great Lakes for shipping both mineral and ingots. During four months of the year, Lake Superior was entirely closed to shipping, so large inventories of mineral accumulated in Hancock, bringing in no revenues. This happened in spite of a hectic effort each

November to get the maximum output from the mine and the Stamp Mill right before the end of the shipping season. One result of this system was that the New York office had to engage in extensive short-term borrowing. In 1866, for example, the Company had total expenditures of nearly $560,000, but at the end of the year held unsold stocks of ingot copper valued at $192,000 and mineral valued at $48,000, while it had liabilities in the form of short-term loans amounting to $240,000.[123]

The precise nature of the Company's marketing arrangements during these years is not entirely clear. In November 1856 John Simpkins was earning a commission of 2½% for the sale of ingot copper.[124] When Simpkins became Secretary-Treasurer in January 1858, his relationship with the Company changed. In March 1861 he made a proposal, which the Quincy Directors accepted, to sell the Company's copper and at the same time supply the Company with short-term credit as well. His proposal included three distinct, but related provisions: he would serve as Secretary-Treasurer for an annual salary of $3,000; he would sell the "Mineral Product" of the mine for a commission of 1¼%; and he would advance up to $50,000 cash to the Company in exchange for its six-month notes, charging the Company 7% annual interest on the notes and a 5% commission. Furthermore, he expected the Company to supply him with "the usual Warehouse Certificates for Copper at a valuation of Fifteen Cents per pound" to use as collateral on the notes.[125] Given the need to use the unsold copper as the basis for the short-term loans the Company needed, this arrangement was logical and convenient for the Company and certainly benefited Simpkins as well. The potential conflict-of-interest inherent in this arrangement is also apparent.

The New York office and particularly the President controlled the operations at the mine location in several ways. The Eastern management was in close contact with market conditions and ordered changes in the overall level of activity at the mine in anticipation of future market developments. Through their overall fiscal control, they were able to monitor spending and force changes simply by withholding funds. The New York office often bought supplies for the mine, sometimes without informing the Agent. All major investment decisions were made by the Directors after consulting the Agent, but he never developed an effective veto over decisions made in New York. Although theoretically responsible to the Directors, he reported to the President and served at his pleasure. The Agent had ultimate authority at the mine location and had a good deal of independence in making most decisions, enjoying wide discretionary powers because of poor communications with New York, especially during the Winter months. Because the Agent typically served as a Director, and occasionally visited the New York office, where he had face-to-face contact with the Eastern officials, he was the only official at the mine to have a reasonably good understanding of the entire operation. He in turn implemented policies and decisions through the administrative structure at the mine.

The managerial structure at the mine became considerably more complex by the mid-1860s than it had been earlier, reflecting the increasing size of the operations there. A fully articulated management hierarchy evolved by the end of the decade, characterized by increasingly specialized positions. There was initially some ambiguity at the very top of the hierarchy. From September 1860 until September 1866, Samuel Stillman Robinson had the title of General Superintendent and was the final authority at the mine. However, George Hardie, previously a Mining Captain, was given the title of Local Superintendent in 1864 and then "Agent" in 1865-1868. The position of General Superintendent disappeared with Robinson's resignation in September 1866 and from that point forward the Agent (occasionally called the Superintendent) was the chief administrative officer. James North Wright replaced Hardie in May 1868 and served as Agent until 1872.

The administrative hierarchy underneath the Agent proceeded along functional lines: all underground work was supervised by the Mining or Underground Captain; surface operations were under the control of the Surface Captain; there was a Superintendent of the Stamp Mill; the office was run by the Mine Clerk; and the medical services were under the direct control of the Company Doctor. All of these men reported directly to the Agent. During the 1860s, there was also a Superintendent of the tram road, but this position was eliminated in 1872 and control turned over to the Surface Captain.[126]

The Quincy Stamp Mill was under the direction of Philip Scheuermann, a German-born millwright who emigrated to the United States in 1850, and then built a stamp mill for the Copper Falls Mining Company at Copper Falls. He remained there for five years before moving to Missouri where he built and operated a sawmill. He returned to Portage Lake in 1859 to design and build the Quincy Stamp Mill. He became Superintendent when the mill opened in 1860 and held that position for nearly thirty years.[127] Working under Scheuermann, there was a Boss Washer and a Tailing House Washer Boss. The Stamp Mill had 113 employees in June 1865, when the Company's total employment was 622 men. The most common occupations were those of washers (54 men), tailing worker (19), and stamp tender (11). The mill also employed a hdnful of highly skilled workers, including four machinists, four carpenters, three blacksmiths, two engineers, and a dozen other miscellaneous trades.[128]

The position of Mine Clerk was an important and sensitive one, requiring a person with education and unquestioned integrity. Three men held this position during the Company's period of initial growth and prosperity--Nathaniel Simpkins, Jr. (August 1858 - March 1863), James North Wright (March 1863 - April 1868), and Andrew J. Corey (November 1868 - November 1872). After assuming the office in

March 1863, Wright explained his new duties in great detail in a letter to his brother. The most important responsibilities were to maintain the books, serve as paymaster, and generally supervise the office. He had two assistants who made the entries into the various account books, but they required considerable supervision. In addition, he had to ride down Quincy Hill to meet every incoming vessel arriving at the Company's dock, to check bills of lading against goods actually received.[129]

Surface operations were under the control of the Surface Captain, sometimes called the Surface Superintendent or Surface Boss. He normally had an Assistant Captain working with him to handle the shift which he did not work. The Surface Captain was responsible for the orderly and efficient movement of the copper rock to the Stamp Mill, the maintenance of all surface structures, including housing, and all other work performed aboveground. In addition, he maintained detailed records of all labor and materials used.[130] John Duncan held this position from about 1864 until 1868, when he was replaced by Donald McCall (Assistant Surface Captain in 1864-1868), who kept this post until the late 1880s.[131]

There were a total of 169 surface workers in June 1865, slightly more than one quarter of the entire labor force. The largest block of workers were 51 general surface laborers, unskilled workers who performed a variety of tasks and were supervised by two "Head" laborers. A total of fifty men worked at the three kilnhouses, with each kilnhouse run by a foreman. There was a Boss Carpenter supervising eighteen men, a Boss Blacksmith with fifteen employees, a Tramroad Superintendent with eleven men, and a Dock Boss supervising eight laborers. The remaining surface workers included six engineers, two firemen, four machinists, a watchman, and four change-house attendants. Finally, there was a Head Engineer (later called the Master Mechanic) who formally worked under the direction of the Surface Captain, but in fact had a great deal of independence.[132] His major duty was to oversee the construction and operation of the surface machinery, particularly the hoisting engines.[133] Frederick Labram, an Englishman by birth and a trained machinist, held the position of Head Engineer from 1864 until July 1889.[134]

The underground workforce in June 1865 consisted of a total of 330 men, slightly more than half the total labor force. It included 210 miners, mostly on contract, with 21 of these comprising an "exploring party," probably working on the Side-Hill Adit. There were 115 underground laborers, including trammers, skip-car fillers, and all other unskilled underground laborers. Finally, five men were identified as timbermen. The Mining Captain had, in addition to his overall responsibility for all underground work, several specific duties as well. He set the contract rates with the miners and measured the work performed. He also maintained detailed accounts of all contracts, time books for wage laborers, and supply accounts, all required by the Clerk.[135]

George Hardie was the Mining Captain between February 1860 and December 1863, when he was replaced by John Cliff, who then served until about 1885. Beginning in March 1860, Hardie had two Assistant Captains, Cliff and James H. Quinn, who held this post until his death in 1876. After Cliff became Mining Captain, two additional Assistant Captains were hired, Thomas Hoatson and William Stephens, giving Cliff a total of three. These Assistant Captains probably conducted most of the on-site supervision underground, leaving the Captain to maintain overall control from his office on the surface. One of the Assistant Captains also had overall authority during the shifts not worked by the Mining Captain.

By the mid-1860s, the contract system of mining was firmly in place at all the copper mines in the district and this system remained essentially unchanged through the rest of Quincy's history. The Mining Captain would let contracts, usually at the beginning of each month, to an individual contractor who would then select a team of men, often relatives, to work with him. The total number in the team, sometimes called a "pair" was always even, because half the men worked each shift. Six men was the normal "pair" or "party". The Captain would set a fixed rate per (cubic) fathom of ground to be excavated, with the rates varying according to the type of work (shaft-sinking, drifting, crosscutting, or stoping) to be done and the hardness of the rock, which the Captain determined by striking it with a pick. At the end of the month, he would measure the ground excavated and report the results to the Clerk. The cost of supplies like steel, candles, powder, and fuse was deducted from the party's earnings before they were paid. The total earnings were then usually divided equally among the miners.

This contract system, however, was <u>not</u> a "piece-rate" or "incentive" system in spite of its appearances. The Mining Captain set the contract rates in order to achieve a predetermined average monthly wage for the miners and rates were adjusted accordingly.[136] The "contract system" was in fact a wage system which may have given miners who were short-sighted temporary incentives to increase output, but over the longer run, may have provided negative incentives. It was a barely-recognizeable remnant of the Cornish tribute system, a genuine incentive system in which miners were paid a share of the value of the copper they produced.[137] This fiction was probably retained to permit the miners, especially the Cornishmen, to preserve the belief that they had not become common wage laborers.

The miners were the only Quincy employees working under a contract system, albeit a fictional one, by the mid-1860s, but this was not the case earlier in the decade. There were many examples of contracts given to windlassmen and hoistmen dating back to the mid-1850s, but these contracts did not involve piece rates. The contractor would agree to hoist "all the rock" for a fixed monthly fee. These contracts were probably just a method used to simplify the administration of the mine, since the Company did not have to hire and supervise the workers involved. However, in 1859 and particularly in 1860, a significant number of Quincy's non-mining workforce were contract laborers. In June 1860 there were 122 of these workers compared to 132 contract miners and a total workforce of 469. There were contracts for breaking and sorting rock, burning and dressing copper, and running rock into the Stamp Mill. In all cases, the contracts were stated in terms of piece rates.[138] The Company probably found this system advantageous until a regular, predictable flow of rock became the norm, at which time administering this system and controlling the workers' behavior probably became increasingly bothersome and costly. To have adjusted rates in the same way they did for the "contract" miners was probably too costly, and since these workers tended to have less leverage against the Company because they were relatively unskilled, the Company simply abolished these contracts and converted the workers into wage laborers. By August 1861, when there were 185 contract miners and 595 employees altogether at the mine location, there were only 22 non-mining contract workers left and by 1863 there were only eleven men (all rock-breakers) in this category.[139]

The overall structure of the labor force and the pay structure for June 1865 are summarized in Table 2.14 below. The wage differentials among ordinary workers with no managerial responsibilities were not as great as these figures seem to indicate because the workers at the bottom of the pay scale were probably apprentices and other boys. The minimum pay for adult common labor was about $35 a month, while the most highly skilled laborers who were not bosses were earning between $50 and $60. In most cases, a Boss, Head, or Superintendent was earning about fifty percent more than the highest paid worker he was supervising. The Company maintained these pay differentials as an incentive for current employees who might hope to advance and also as a means for attracting and retaining its middle-level management. Examining only the pay figures downplays the real differentials between the top management and everyone else. With the exception of the Dock Boss and the Assistant Clerk, all those individuals earning $100 a month and above received rent-free housing, free cordwood, horses, and other perquisites along with their salaries.

Before looking at the Company's middle and upper level managers in some detail, it is important to try to examine the ordinary workers more closely. These hundreds of individuals have left few written records. We in fact do not know a great deal about them, except that they were predominantly recent immigrants to Michigan and for the most part, they had recently come to the United States as well. The Quincy workers were already a mixture of several distinct nationalities in the 1860s and this diversity was reflected in the names given to the Company-owned clusters of housing atop Quincy Hill - Swedetown, Limerick, and Frenchtown. To attempt to describe the character and habits of these immigrants is difficult, due to insufficient data, and of little value. At worst, such an effort would produce ethnic caracatures.[140]

TABLE 2.14: QUINCY MINING COMPANY LABOR FORCE, JUNE 1865

Number of Men	Position	Monthly Wage
1	Superintendent	$350
1	Agent	333
1	Mine Clerk	150
1	Assistant Mine Clerk	100
	Underground Mining	
1	Mining Captain	150
3	Assistant Captain	100
5	Timberman	65-70
1	Head, Exploring Party	65
20	Exploring Party	20-52
189	Miner	55-60
115	Laborer	25-43
	Surface	
1	Surface Captain	100
1	Tramroad Superintendent	70
10	Tramroad Laborer	35-45
1	Dock Boss	100
8	Dock Laborer	35-45
2	Surface Labor Boss	70
51	Surface Laborer	20-50
3	Kilnhouse Boss	50
47	Kilnhouse Laborer	35
1	Head Machinist	100
3	Machinist	26-60
6	Engineer	50-52
2	Fireman	38
1	Boss Blacksmith	80
14	Blacksmith	38-65
1	Boss Carpenter	90
17	Carpenter	40-55
2	Change House Attendant	38
1	Watchman	50
1	Civil Engineer	50
1	Unspecified	65

Table 2.14 continued here:

Number of Men	Position	Monthly Wage
	Stamp Mill	
1	Superintendent	$100
1	Tailing Washer Boss	60
18	Tailing Washer	18-39
1	Boss Washer	80
53	Washer	15-55
16	Stamp Tender	40-52
2	Stamp Repairer	42
1	Head Machinist	78
3	Machinist	60
1	Head Carpenter	60
3	Carpenter	52-55
2	Engineer	55
2	Fireman	52
1	Cooper	55
1	Mason	78
1	Watchman	30
1	Wood Passer	40

SOURCE: QMC, Payroll Accounts, June 1865.

The national origin of the Quincy workers is summarized in Table 2.15 below. The principal national groups represented include the Cornish, Irish, and Germans, with a scattering of Scots, Englishmen, and French-Canadians. These figures do not include the top managers, who will be considered separately. The Cornish were heavily concentrated in mining and underground labor but could be found in all phases of the Company's operations, particularly in skilled positions. Overall, the Germans and Irish tended to hold the less skilled jobs, with Germans heavily represented at the Stamp Mill and the Irish proportionately more involved in mining and underground labor. At this point at least, occupations and the location of work did not follow sharp ethnic lines. There were at least two nationalities with substantial numbers in every major occupational grouping. Since the Cornish made up half the workforce, it is not surprising that they could be found in

TABLE 2.15: QUINCY MINING COMPANY EMPLOYMENT, BY NATIONAL ORIGINS, JUNE 1865

	Cornish	German	Irish	English/ Scottish	Other	Total
Miners	129	13	58	8	-	208
Underground Labor	42	32	36	3	-	113
General Surface Labor, Including Tram Road and Dock	29	21	7	12	1	70
Kilnhouse Labor	11	24	11	2	-	49
Skilled Surface Labor	26	5	3	2	5	41
Stamp Mill-General Labor	43	30	14	1	-	88
Stamp Mill-Skilled Labor	9	13	1	1	1	25
Totals	289	138	130	29	8	594

SOURCE: QMC, Payroll Accounts, June 1865.

substantial numbers everywhere. However, they did not monopolize mining or the skilled occupations and fewer than half of them were miners.

The managers at the mine location also had diverse backgrounds. None of the ten middle-level managers for whom we have some detailed biographical information were born in the United States. Scheurermann, the Stamp Mill Superintendent was a German; Fred Labram was English; and the Boss Blacksmith, John Morrison, was born in Scotland. Of the seven Captains and Assistant Captains at the mine during the 1860s, only two (Cliff and Stephens) were Cornish. The rest included three Scots (Hardie, Hoatson, and McCall), a Canadian (Duncan), and James Quinn, born in Ireland.[142] However, the positions of Superintendent, Agent and Mine Clerk were filled by Eastern native-born Protestants, generally with considerable formal education. The most significant of these people included Ransom Shelden (born in upstate New York), Samuel W. Hill (Vermont), S. S. Robinson (New Hampshire), and James North Wright (Connecticut).[143] In a letter to a long-time friend in Claremont, New Hampshire, Robinson said that there were many responsible positions open in the copper district for "steady, wide-awake-energetic-practical Yankee Boys."[144] It was these people, who might begin as an Assistant Mine Clerk, that could realistically expect to become Agents in the future. Robinson then added,

> I do not care whether he ever saw a mine or not if he has good common sense, a fair New England Education and is honest and energetic and industrious.[145]

The careers of S. S. Robinson, George Hardie, and James North Wright illustrate the Company's constant struggle to retain good managers. Samuel Stillman Robinson was born in Cornish, New Hampshire in 1824 and worked as a teacher in Windsor, Vermont before coming to the Upper Peninsula in 1853, when he began managing the Sharon and Derby (iron) Mine in Gogebic County. He ran a lumber business in the Lower Peninsula in 1855-1857, moved to Minnesota, and then to Detroit before assuming the Superintendency of the Quincy in September 1860.[146] In early July 1863, Robinson had become unhappy with the "Frontier" qualities of the copper district and inquired about a position at a Waterbury, Connecticut brass manufacturing firm, stating that he wanted to move so that "my children can enjoy a different state of society from this and better facilities for education."[147] He informed Mason a few weeks later that he had been offered a salary of $5,000 and asked Mason to make a counter-offer, since his contract with Quincy would expire on September 1st. Subsequent letters show both men skillfully maneuvering for position. Mason said that he had to bring the matter to the Directors and was sufficiently confident of Hardie's abilities to recommend him for the Superintendency if Robinson were to leave.[148] The two were still negotiating in early September, when Robinson almost accepted a position at the Evergreen Bluff Mine, an ironic name for a potential employer that Robinson was probably not seriously considering at all.[149] Mason finally agreed to raise Robinson's salary from $3,000 to $4,200 rather than lose his services.[150] The decision to elevate Hardie to the position of Local Superintendent was probably made to weaken Robinson's future bargaining position. Robinson ultimately resigned in 1866 to accept a position with a brass foundry in Waterbury, citing his concern about his children's education, but adding,

> Besides all this I need not disguise the fact that I am tiring of the continued nervous strain induced by this management and (I) am feeling discouraged to the extent that I think I should be more valuable (if I were) to change for a while to something else.[151]

George Hardie, who replaced Robinson in September 1866, but with the title of Agent, was the first experienced "mining man" to reach a top managerial position within the Company. Hardie joined Quincy in May 1859 as Mining Captain, became the Local Superintendent in 1864 and then Agent in 1865. When Hardie resigned his position in May 1868 to accept a post at the Calumet and Helca Mine, several other key Quincy managers went with him, including three Captains (Duncan, Hoatson, and Stephens), the Boss Blacksmith Morrison, and one other Boss.[152]

James North Wright's career is perhaps more typical of the way in which the Company tried to retain competent managers. He was born in Haddam, Connecticut in 1839 and came to Lake Superior in 1859 to become Clerk at the Minnesota Mine.[153] Before Wright began working at the Quincy as Assistant Clerk in October 1862, Nathaniel Simpkins, Jr., who had served as Quincy's Mine Clerk since August 1858, had already indicated his desire to leave the post. Robinson suggested to Mason that the new Clerk be given a salary but no perquisites, but conceded that this would be difficult because Simpkins had already established the precedent.[154] When Wright accepted the Assistant Clerk position at a salary of $70 a month, he knew that Simpkins would resign the following Spring and expected to be offered the post at a salary of at least $1,200.[155] He also noted that the Quincy was known as "the best officered mine at Portage Lake."[156]

Wright was appointed Mine Clerk in March 1863 with a salary of $1,400 and the use of a house.[157] The Company was so pleased with his work that it gave him a $200 raise in October 1863, an increase he had not even requested.[158] By June 1865 he was earning $1,800 per annum. Hardie resigned in May 1868, and upon his recommendation, the Company Directors appointed Wright as Agent, at a salary of $3,000 a year, plus the usual perquisites.[159] He quickly proved his ability to supervise the entire mine operation and was offered the position of Superintendent at the Calumet and Hecla Mine, which he accepted in November 1872.[160] Despite Quincy's efforts to retain its top managers, the Company lost many of its best men to its giant competitor ten miles to the north.

Quincy at the Beginning of the 1870s

The Company's achievements during the difficult decade of the 1860s need to be placed in the broader context of the overall development of the Michigan copper district. The mass or fissure mines had dominated the district until the late 1850s, when the three mines on the Pewabic Lode (Quincy, Pewabic, and Franklin) began exploiting amygdaloid copper. In 1860, these three producers had a combined output of 2,085 tons, compared to 2,304 tons for the Cliff and Minnesota Mines, and a total district production of 6,034 tons. By 1865, the two great fissure mines (Cliff and Minnesota) produced only 948 tons, while the three Pewabic Lode mines had a combined output of 2,576 tons, compared to the district's total of 7,179 tons. By the end of the decade, Quincy had become the dominant producer on the Pewabic Lode because its two principal rivals did not recover from the disastrous postwar depression. The Pewabic Mine's peak production was 958 tons in 1860, roughly the same as Quincy's that year, but by 1871 it was producing only 222 tons compared to Quincy's 1,204. The Franklin Mine was developed a few years after Pewabic and Quincy, reached a peak output of 819 tons in 1866 and then fell to 300 tons by 1871. So Quincy had become the premier mine on the Pewabic Lode by the early 1870s and would have been the premier mine in the entire district except for the phenominal development of the Calumet and Hecla beginning in 1866. Production there jumped from 675 tons in 1867 to 8,111 tons in 1871, dwarfing Quincy and dominating the entire Michigan copper district.[161]

The Calumet and Hecla discoveries were the most serious challenge the Quincy had to face in the 1870s. In December 1866, only two years before he left the Quincy to work at the Calumet and Hecla, George Hardie gave Mason an extensive confidential assessment of the newly-discovered Calumet deposits. The early explorations revealed a fabulously rich vein, but Hardie believed that it would not remain as rich when fully explored at greater depths. He reassured Mason:

> It will take another year or maybe two to open mines on this new formation (and) even if they do hold out in depth and length (they) cannot surely (sic) glut the copper market of the world. So I should hardly think that they are going to entirely swamp the old minex just yet, after all the labor and vexation of spirit we have had to get them this far. I therefore cannot see why this is not a good time to buy into Quincy.[162]

While remaining skeptical about the richness of the Calumet (conglomerate) formation, Hardie nevertheless made the ominous observation that "had they a mine opened as (fully as) we have and (it proved to be) as rich (as their initial discoveries) we could not begin to compete with them."[163] Hardie's judgment was faulty on all counts, for the Calumet deposits proved to be as rich as they first appeared, but Quincy nevertheless survived this competition and achieved great success in the following decades.

NOTES

[1]There were still several shareholders from Philadelphia who held large blocks of shares, such as Theodore Walters (630 shares), Quincy Shaw (400), Truman Smith (400), and George Hicks (200). Ownership was considerably more diffuse than earlier, with the ten largest shareholders controlling less than half the total shares in May 1856. The largest block of shares (864) was held by Head & Perkins, a Boston brokerage house which probably held proxies for dozens of smaller investors. The five new Oirectors owned a total of only 650 shares. QMC, Directors' Minutes, Oirectors' Meeting of 21 May 1856.

[2]Ibid.

[3]Ibid., Meeting of 8 October 1857.

[4]Ibid., Meeting of 10 November 1857.

[5]Ibid., Meeting of 6 January 1858.

[6]A radical change had taken place in the ownership of Quincy stock, including a heavy concentration of the stock into a few hands. In March 1858, the five largest stockholders held half the stock and the ten largest owned more than two-thirds of the total. The principal stockholders and the shares held: the Mason family (5,093); the Sheldon family (1,965); the Douglass family (1,965); Rev. George Duffield (1,000); A. H. Dey (750); the Hicks family (750); S. S. Barnard (665); Charles Van Brunt (625); W. Hickok (500); and C. W. Sanford (500). QMC, Assessment Lists, 1858-1860, "List of Stockholders of Quincy Mining Company, March 5th, 1858."

[7]The dates and amounts of assessments (per share) were: October 1856 ($1.00); March 1857 ($1.00); August 1857 ($2.00); March 1858 ($1.00); April 1859 ($2.00); August 1859 ($2.00); and February 1860 ($1.20).

[8]QMC, Directors' Minutes, Directors' Meeting of 8 October 1857. This new issue was handled by exchanging five new shares for two of the old ones already outstanding, so that the previous assessments of $9.50 per share were converted to $3.80 per share of the new stock.

[9]QMC, Contract Book, 1856-1860, passim.

[10]Ibid., entry for 20 November 1856.

[11]Ibid., entry for 13 January 1857 and passim.

[12]Ibid., passim.

[13]The Pewabic Mining Company discovered the Pewabic Vein in October 1855 and immediately began to exploit it intensively. Their production of ingot copper jumped from nil in 1854 to 11 tons in 1855, and then to 66 tons in 1856. However, like the Quincy, they had spent considerable resources in futile explorations before finally locating a worthwhile deposit. In 1853 - October 1855, with Ransom Shelden serving as their Agent, the Pewabic Mining Company spent $18,287 on unproductive explorations. See Report of the Pewabic Mining Company, March 1858 (Boston, 1858), p. 3 and Report of the Directors to the Stockholders of the Pewabic Mining Company, Issued May 10, 1859 (Boston, 1859), pp. 6, 23.

[14]QMC, Directors' Minutes, Meeting of 15 June 1858.

[15]Sales figures are from QMC, Annual Report for 1861, p. 6.

[16]An unsigned article, dated 30 March 1858, which appeared in the Detroit Daily Free Press, 29 April 1858 notes that the Pewabic Vein was worked "upon tribute" when first opened; an insert in Samuel W. Hill's "Longitudinal Section of the Quincy Mine, Nov. 16, 1859," labelled "Mine As Opened June 15, 1858" shows a 900 foot surface section worked by tributors; and the QMC, Returns of Labor, 1857-1864 shows substantial payments to tributors in 1857 and 1858. There was a single payment for August-October 1857 for more than fourteen tons of copper, or roughly one-quarter of the total sales for 1857.

[17]"The Portage Lake Mining District, March 30, 1858," Detroit Daily Free Press, XXI, Number 277, 29 April 1858, p. 1.

[18]Ibid.

[19]Ibid.

[20]QMC, Annual Report For 1861, p. 9.

[21]QMC, Contract Book, 1856-1860, passim. The precise location of this work is not entirely clear. Two contracts called for work to be done "Southwest of Old Buildings" one for exploration "above Barn" and six referred to work to be done "Below New Barn in Open Cut."

[22]Samuel W. Hill, "Longitudinal Section of the Quincy Mine, Nov. 16, 1859" and "Geological Diagram of the Quincy and Hancock Locations, November 1859."

[23]Hill, "Longitudinal Section."

[24]QMC, Contract Book, 1856-1860, passim.

[25]Hill, "Geological Diagram."

[26]Charles DeWitt Lawton, A Review of Lake Superior Mining and A Sketch of the History and Operation of the Quincy Mining Company (New York, 1907), p. 22.

[27]QMC, Contract Book, 1856-1860. p. 140. They were originally numbered One through Three, from south to north. The numbering order was reversed, so that the old Number Three became the new Number Two, the old Number Two became the new Number Three, and the old Number One became the new Number Four. Thus, they left room for another shaft further north of the existing ones and when built, it was called Number One.

[28]Ibid., passim.

[29]Hill, "Longitudinal Section."

[30]In the Annual Report For 1861 which summarized the Company's early accounts, there is a lump sum ($292,727) given for all real estate purchases and "permanent improvements" made since 1856. The remaining accounts that have survived are ambiguous with regard to investment. Most of the costs for construction are subsumed under "Mining Costs" and "Supply Costs."

[31]QMC, "Inventory of Buildings, 1 March 1859". The principal buildings and their valuations were: Supt. House ($1,200), Dock House ($1,100), four boarding houses ($1,900), twenty-seven log houses ($2,840), two Mining Captain's houses ($1,500), Office ($1,000), Blacksmith Shop ($900), Powder House ($150), two Engine Houses ($200), four Shaft Houses ($195), three Kiln Sheds ($100), and one Horse Whim ($100).

[32]Ibid.

[33]QMC, Annual Report For 1861, p. 9.

[34]QMC, "Inventory of Equipment and Supplies, 1 January 1862."

[35]An anonymous report dated 27 February 1860 in the Detroit Daily Free Press, XXIII, Number 244, 21 March 1860, p. 2 indicated that the stamp mill was about to start up in early March.

[36]QMC, Journal, 1859-1861, p. 138.

[37]QMC, Journal, 1861-1863, p. 94. They spent a total of $14,127 on the stamp mill and $3,144 on the tramroad. The Pewabic Mining Company one of Quincy's neighbors, spent $106,625 building its stamp mill in 1858-1860, while the Franklin Mining Company valued their stamp mill, including all buildings and machinery, at $96,504 in 1862. See Pewabic Mining Company, Annual Report For 1862, p. 6 and Franklin Mining Company, Annual Report For 1862, p. 15.

[38]QMC, "Inventory of Buildings, 1 March 1859".

[39]QMC, Annual Report For 1861, p. 17.

[40]Gates, Michigan Copper, p. 19.

[41]Ibid. and John Harris Forster, "Lake Superior Country," Michigan Pioneer Collections, VII (1885), pp. 140-141.

[42]QMC Annual Report For 1861, p. 12.

[43]Gates, Michigan Copper, p. 19.

[44]QMC, Annual Report For 1865, p. 9.

[45]QMC, Annual Report For 1862, p. 13.

[46]Ibid., pp. 6, 7. The interest payments made by the Company were:

In the year ending 1 March 1859	$ 1,294
" " 1 March 1860	2,375
" " 1 March 1861	9,758
March 1, 1861-31 Dec. 1861	10,739

[47]QMC, Annual Report For 1862, p. 3.

[48]Gates, Michigan Copper, p. 15. However, if the prices are expressed in terms of gold, they only increased to 23 cents in 1864.

[49]Ibid., p. 197.

[50]Ibid., pp. 16, 17.

[51]WMC, Annual Report For 1862, p. 6.

[52]S. S. Robinson to Thomas F. Mason, 8 August 1862. According to one source, the mining companies bought substitutes for the Draft in 1861 and 1862 to protect their own employees. See Orrin W. Robinson, "Recollections of Civil War Conditions in the Copper Country," Michigan History, III, (1919), p. 600.

[53]Robinson to Mason, 25 September 1862.

[54]Robinson to Mason, 13 December 1862.

[55]Ibid.

[56]QMC, Annual Report For 1863, p. 14.

[57]Ibid., p. 11.

[58]QMC, Annual Report For 1864, p. 11 and Annual Report For 1865, p. 13.

[59]In an open letter to the Governor of Michigan in August 1863, S. S. Robinson asked the Governor to appeal to Washington for an exemption for the Upper Peninsula. He argued that the impact of the Draft on the Copper district was especially severe because a high percentage of the miners were foreign-born, making any quota unreasonable. At the same time, these foreign-born miners were so frightened by the Draft that they would flee the district even though they were not eligible. This letter is in the Robinson Collection, Bentley Historical Collection.

[60]QMC, Annual Report For 1863, pp. 5, 6.

[61]QMC, Annual Report For 1864, pp. 6, 11.

[62]Robinson, "Recollections," pp. 601-602 and QMC, Journal, 1864-1866, pp. 59, 67, 94, 134, 142, and 213.

[63]Forster, "Lake Superior Country," p. 142. James Fischer, in his "Historical Sketch of the Lake Superior Copper District," in the 1924 Keweenawan, p. 255, claims that there were only about 400 new men brought into the district in 1864 as a result of these efforts.

[64]Robinson, "Recollections," pp. 602-603.

[65]QMC, Journal, 1864-1866, p. 138-141 and 233-234.

[66]It is clear from a letter from James North Wright to his wife, Susie Wright, 4 June 1865 that 5wedetown was indeed inhabited by Swedish families. 5everal authors have implied that few 5wedes actually worked for the Company. See David Coon, "The Quincy Mine," Michigan History, XXIV (1940), p. 95 and William H. Pyne, "Quincy Mine: The Old Reliable," Michigan History, LXI (1957), p. 225.

[67]QMC, Annual Report For 1864, p. 5.

[68]QMC, Annual Report For 1865, pp. 8, 13.

[69]QMC, Directors' Minutes, 1858-1878, pp. 109-110 and Annual Report for 1863, p. 6. Apparently, the timber lands previously purchased by the Company had been exhausted by this time. According to the Annual Report For 1861, p. 17, the Company already owned 228 acres of timberland, located on Portage Lake southeast of the mine location.

[70]S. 5. Robinson to James North Wright, 27 November 1863.

[71]QMC, Annual Report for 1864, p. 13.

[72]Ibid.

[73]John Harris Forster, "War Times in the Copper Mines," Michigan Pioneer and Historical Collections, XVIII (1891), pp. 377-379 and Forster, "Lake Superior Country," pp. 141-142.

[74]Forster, "War Times," p. 379.

[75]Robinson, "Recollections," pp. 603-604.

[76]Lawton, Review, p. 28.

[77]QMC, Annual Report For 1865, p. 4.

[78]QMC, Annual Reports For 1864-1871, passim.

[79]Ibid.

[80]Gates, Michigan Copper, pp. 39-42.

[81]Record Book of the Houghton County Mine Agents Union, Meeting of 5 March 1869. The mines represented included the Calumet, Hecla, Quincy, Franklin, Pewabic, Adams, Grand Portage, South Pewabic, Agawam, and Isle Royale.

[82]Ibid.

[83]Ibid., Meetings of 5 March and 30 March 1869.

[84]Gates, Michigan Copper, p. 8.

[85]QMC, Annual Report for 1865, pp. 6, 7.

[86]Ibid., p. 5.

[87]Gates, Michigan Copper, pp. 45-46.

[88]QMC, Annual Reports For 1864, 1865, and 1868.

[89]QMC, Journal, 1864-1866, pp. 285, 614.

[90]QMC, Annual Report For 1865, p. 7.

[91]QMC, Journal, 1867-1871, passim.

[92]QMC, Annual Report for 1863, p. 22.

[93]QMC, Journal, 1865-1871, pp. 344, 497, 644, and 781.

[94]The expenditures were:

1864	-	$15,335
1865	-	35,435
1866	-	13,356
1867	-	3,014
1868	-	1,414

See the Annual Reports For 1864-1868.

[95]QMC, Annual Report For 1864, p. 5.

[96]Ibid., pp. 17-18.

[97]QMC, Annual Report For 1865, p. 14. The QMC Contract Book, 1864-1866, includes scores of contracts for exploring, earth excavation, shaft-sinking, and drifting on the "Side Hill."

[98]QMC, Annual Report For 1865, p. 19.

[99]Ibid., p. 6.

[100]Ibid.

[101]QMC, Annual Report For 1866, p. 15.

[102]QMC, Annual Report For 1867, pp. 11, 15.

[103]QMC, Annual Report For 1868, pp. 18, 22.

[104]The Mineral Yield (ingot copper as a share of mineral, by weight) was:

1858	-	46.4%
1859	-	53.1
1860	-	65.8
1861	-	72.9
1862	-	84.8

The Company included mass copper in the totals for "Mineral" and in calculating the Mineral Yield. For the 1860s, this is not a major problem because the share of mass copper in the total is both small and stable. This share varied from 3.9% in 1869 to 7.3% in 1864. For the two years under consideration here, 1862 and 1870, the share was 6.3% and 5.6% respectively. See QMC, Annual Reports For 1862-1871, passim.

[105]The difference between these two Mineral Yields is in fact highly significant, for by itself it would produce a difference of nine pounds of copper for each ton of rock processed. For 1871, when the share of mineral produced from rock fell to 2.4%, the amount of ingot copper produced per ton of rock treated fell to only 38 pounds, a decline of 22% compared to 1862.

[106]All of the data relating to costs in 1862 and 1870 are from the Annual Reports for those years unless otherwise noted.

[107]Pewabic Mining Company, Annual Report For 1862, p. 9 and Franklin Mining Company, Annual Report For 1863, p. 10. Because these two producers lump all of their marketing expenses together, direct comparisons with Quincy are ambiguous. Overall, the Quincy's marketing expenses together, direct comparisons with Quincy are ambiguous. Overall, the Quincy's marketing expenses seemed roughly the same as the Franklin's, but lower than Pewabic's.

[108]In the 1860s, for example, there were typically about twenty men in this position, while the payments they received were roughly ten percent of the total paid to contract miners. The numbers of men are not specified in the Annual Reports, but can be found in the QMC, Returns of Labor, 1857-1864.

[109]According to an unsigned, undated estimate of mining costs throughout the district in 1861, found among the Quincy Directors' Minutes, between one tenth and one quarter of all ground broken was "poor rock".

[110]Cost data are from the Annual Reports.

[111]QMC, Assessment Lists, Assessment of 5 March 1858 and Dividend Payments Lists, Dividend Payments of 27 February 1865 and 17 February 1868.

[112]QMC, Directors' Minutes, Directors' Meetings of 7 March 1867 and 4 March 1868.

[113]The office was at 4 Hanover Street in 1858-1860, 3 Hanover Street in 1861-1863, 51 Exchange Place in 1864-May 1869, and then at 43 Exchange Place in May 1869-1871.

[114]QMC, Directors' Minutes, Directors' Meeting of 17 January 1863.

[115]QMC, Annual Report For 1863, p. 6. The salaries of the Company officials are consistently lumped together with other items and charged to "General Surface Costs" in the accounts. This is a peculiar practice and can only be understood as an attempt to deceive the stockholders or at least withhold information from them.

[116]QMC, Ledger, 1860-1862, p. 4.

[117]Robinson, "Recollections," p. 609.

[118]Gates, Michigan Copper, pp. 28-30, 42-43; James B. Copper, "Historical Sketch of Smelting and Refining Lake Copper," Proceedings of the Lake Superior Mining Institute, VII (1901), pp. 45-46; and "The Detroit and Lake Superior Copper Company's Smelting Works," Michigan Pioneer Collections, XXVIII (1900), pp. 647-652.

[119]QMC, Day Book, 1856-1857, pp. 12, 13, 23; New York Journal, 1857-1872, passim; and Annual Reports, 1861-1872, passim. The Quincy Directors considered proposals from both the Portage Lake Smelting Company and the Waterbury and Detroit Copper Company in 1866, and agreed to a two-year contract with the latter. See QMC, Directors' Minutes, Directors' Meeting of 5 January 1866.

[120]QMC, New York Journal, 1857-1872, passim and Directors' Minutes, Directors' Meeting of 5 January 1866.

[121]Gates, Michigan Copper, p. 43.

[122]Ibid., pp. 35-36.

[123]QMC, Annual Report For 1866, pp. 6, 7.

[124]QMC, Day Book, 1856-1857, p. 11.

[125]QMC, Directors' Minutes, Directors' Meeting of 6 March 1861.

[126]Andrew J. Corey to William Rogers Todd, 12 December 1872.

[127]Western Historical Company, History of the Upper Peninsula of Michigan (Chicago, 1883), p. 319.

[128]These and subsequent details on employment for June 1865 are taken from the Company's Payroll Accounts for 1865.

[129]James North Wright to Edward Lockwood Wright, 23 March 1863.

[130]A distinct set of Time Books for surface laborers and a distinct set of supply accounts for work done on the surface have survived.

[131]Western Historical Company, History, p. 303.

[132]He kept his own separate set of accounts for the labor and materials that he used in his work.

[133]QMC, Engineer's Time and Account Books, 1864-1892, passim.

[134]Western Historical Company, History, pp. 318-319.

[135]A good brief description of the duties of the Captain can be found in Thomas Egleston, "Copper Mining on Lake Superior," Transactions of the American Institute of Mining Engineers, VI (1877-78), pp. 278-281.

[136]Ibid., p. 280

[137]Jenkin, Cornish Miner, pp. 139, 204, 227.

[138]QMC, Returns of Labor, 1857-1864, entries for June 1861.

[139]Ibid., entries for August 1861 and December 1863.

[140]The most notable works on the early wave of immigrants, especially the Cornish include Roy W. Drier, editor, Copper Country Tales (Calumet, Michigan, 1967) and More Copper Country Tales (Calumet, Michigan 1968) John Rowe, The Hard Rock Men: Cornish Immigrants and the North American Mining Frontier (New York, 1974); A. L. Rowse, The Cousin Jacks: The Cornish in America (Glendale, California, 1967).

[141]The data on national origins were painstakingly compiled by Cathy Silverstein, who recorded the names of 622 individuals and then ascertained their most likely national origin. Here, we assumed that most of these individuals were recent immigrants to the copper district and to the United States as well.

[142]Western Historical Company, History, pp. 303-306, 318, 319, and Houghton County, Record of Deaths, I, 1867-1888, p. 71.

[143]Western Historical Company, History, pp. 285, 296, 305 and Michigan Pioneer Collections, XVII (1890), p. 22.

[144]S. S. Robinson to J. P. Brewer, 18 December 1863.

[145]Ibid.

[146]Western Historical Company, History, p. 296 and Orrin W. Robinson, Early Days of the Lake Superior Copper Country (Houghton, Michigan, 1938), p. 8.

[147]S. S. Robinson to F. J. Kingsbury, 2 July 1863.

[148]Mason to Robinson, 4 August and 11 August 1863.

[149]Robinson to John Simpkins, 10 September 1863.

[150]Robinson to W. C. Colburn, 30 September 1863.

[151]Robinson to Mason, 4 July 1866.

[152]James North Wright to James Lockwood Wright, 27 May 1868. This and other letters from James North Wright to family members in Connecticut are in the possession of the Wright family.

[153]Western Historical Company, History, p. 305.

[154]Robinson to Mason, 21 June 1862.

[155]James North Wright to James Lockwood Wright, 30 October 1862.

[156]*Ibid.*

[157]James North Wright to Edward L. Wright, 23 March 1863.

[158]James North Wright to James L. Wright, 1 October 1863.

[159]QMC, *Directors' Minutes*, Directors' Meeting of 17 April 1868.

[160]Andrew J. Corey to W. W. Bailey, 16 November 1872.

[161]Production figures are taken from the Statistical Table attached to the *Report of the Commissioner of Mineral Statistics of the State of Michigan For 1882* (Lansing, Michigan, 1883).

[162]George Hardie to Thomas F. Mason, 15 December 1866, p. 5.

[163]*Ibid.*, p. 2.

CHAPTER THREE: PROGRESS AND PROFITS -- THE 1870s and 1880s

Compared to the difficult decade of the 1860s and the revolutionary expansion of the Company's operations which began in 1888, the intervening years were relatively calm. There were several minor disruptions at the mine and in the Eastern offices in 1872-1874, including the temporary ouster of Mason from the Presidency and a serious, but temporary reduction of profits in 1877-1879. This was a period of relative stability in copper markets largely as a result of successful pooling and price-fixing agreements among the major producers, including Quincy. It was not a period of stagnation, but rather one of generally gradual change. There were, however, several significant technological changes which had considerable impact on the mine's operating efficiency--the adoption of the rockhouse in 1872, the extensive use of air drills beginning in 1880, and a variety of less spectacular but nonetheless significant new technologies. These developments combined to make a major expansion of the mine both desirable and feasible by the mid-1880s. Quincy purchased the adjoining Pewabic Mining Company property in 1884 but a series of legal complications delayed the takeover of the property until 1891. Within a few years thereafter, certainly by 1900, the size and character of the Company's operations had been revolutionized. The developments during the period 1872-1886 established the foundations for the subsequent changes.

The Struggles of the 1870s

The decade began with a struggle for control of the Company among the Eastern stockholders and a series of disruptions at the mine itself. Boston stockholders owned a majority of Quincy shares by early 1868 and Mason was apparently not astute enough to pacify them by establishing a permanent Transfer Office in Boston. Mason anticipated a stockholders' revolt at the Annual Meeting of March 6, 1872 and belatedly tried to prevent his own ouster by sending an ominous note to the stockholders on February 5th:

> It is important that a full representation of Shareholders should be made at the Annual Meeting of the Company, March 6, 1872. An effort will be made to divide the active capital of the Company, and to remove (the) office to Boston-involving a change of management. Stockholders who cannot be present (at the meeting) desirous of sustaining past management, can send their Proxies to Wm. Hart Smith, Treasurer, Box 3311, New York.[1]

The expected confrontation took place, with two sets of candidates appearing for the elected positions. The Mason slate of five Directors included himself, T. Henry Perkins and F. B. Wallace, both long-term Mason allies already serving as Directors; the Bostonian Cyrus Arnold; and James North Wright, the Company Agent. It also included William Rogers Todd for Secretary and W. Hart Smith for Treasurer. The opposition slate consisted of George F. Bemis, J. Prichard (Director since 1867), R. M. Clark, as well as Arnold and Wright. It also included Todd for Secretary, but more significantly, Horatio Bigelow as the candidate for Treasurer. There were a total of 16,441 shares represented at the meeting and the Bemis slate won handily, receiving 11,503 shares. The new Directors then agreed to move the Company's offices to Boston.[2]

Although Bemis replaced Mason as President, this takeover was engineered by Horatio Bigelow with the active cooperation of the Clark family. Bigelow had been a major speculator in Michigan copper companies from the 1850s onwards.[3] His power was reflected in the salaries paid to the new Quincy officers in March 1872. Bemis was given an annual salary of $1,000, Todd was paid $2,000, while Bigelow earned

$3,500.[4] At the next Annual Meeting, Bigelow was elected President and Todd became Secretary-Treasurer, but the Directors also specified that "no loans be made without the approval of either the President or Mr. R. M. Clark."[5] The takeover apparently took place because Bigelow was able to appeal to the self-interest of the Boston stockholders, who held 12,304 shares of the total of 20,000 in February 1872. Mason was still the largest stockholder, with 1,786 shares, while the Clark family, Bemis, Bigelow, Prichard, and Arnold combined owned only 1,687 shares.[6]

Bigelow remained in power until March 1875, when he became a victim of circumstances beyond his control. After paying dividends of $260,000 in 1871 and $250,000 in 1872, Quincy returned only $160,000 to the shareholders in each of the following three years.[7] There was a minor crisis at the mine in November 1872 when horse distemper killed many of the work animals and severely disrupted surface operations.[8] A year later, the Company was victimized by the national financial crisis, commonly called the Panic of 1873, which began in September.[9] A. J. Corey, the Agent at the time, reported severe difficulties by early November. They were unable to sell copper, so they could not meet expenses, including one payroll which had to be postponed. They had already reduced wages and laid off miners and Corey recommended more of the same medicine. He also suggested that the Company try to pay for supplies with long-term notes, but feared they might bankrupt their suppliers in the process.[10] This was more than just a short-term crisis, for the average selling price of Quincy copper fell from about 33 cents in 1872 to 22 cents in 1874.[11]

Mason was able to regain control over the Company in March 1875 and then served continuously as President until his death in 1899. The Company's relatively poor performance during the Bigelow years must have created dissatisfaction among the stockholders. At their meeting of March 3rd, 1875, they elected a new Board of Directors by a margin of 9,531 to 5,353 shares. The new Directors (Mason, F. B. Wallace, T. Henry Perkins, Henry S. Ripley, and A. J. Corey) immediately voted to return the Company headquarters to New York City.[12] Mason's position was not seriously threatened again, largely because of his success in managing the Company and his ability to effectively manipulate the Board of Directors and stockholders. When the Company's stock was increased from 20,000 to 40,000 shares in 1878, the Quincy Directors authorized Mason to purchase some 3,800 shares for the Company, thus assuring Mason control over a significant block of the new shares.[13] The Company also established a permanent Transfer Office in Boston in December 1880, run by Nathan Daniels, who subsequently became a Director.[14] Mason had finally recognized the need to provide the Boston stockholders with this service.

The increase in stock previously alluded to was the result of the legal reorganization of the Quincy in March 1878. The Company had been operating under a charter issued by the Michigan Legislature on March 30th, 1848 which gave it a legal life of thirty years. At a special Stockholders' Meeting of March 6th, 1878 the Company extended its legal life for an additional thirty years, with few substantive changes. They drew up new Articles of Association and By-laws, as required by law, but essentially all they did was transfer the assets and liabilities from the "Quincy Mining Company" which was about to expire to a new "Quincy Mining Company." The capital of the new company was enlarged to $1 million divided into 40,000 shares of $25 each. This was accomplished by giving each stockholder two shares of the new stock for every share of the old stock already held.[15] This was essentially a paper transaction which served to bring the face value of the stock and the invested capital more in line with the Company's net worth. Even in 1867-1868, the depth of the postwar depression, Quincy stock never sold for less than $15 a share, while carrying a face value of $10.[16] By the end of 1877, the Company had invested about $780,000 at the mine location and had an operating surplus of $2.6 million on hand, so the enlargement of the firm's nominal capital to $1 million was still an extremely conservative revaluation.[17]

After experiencing sharply fluctuating copper prices in the 1860s, Quincy and the other Michigan producers tried to manipulate the copper market in the 1870s through a pooling arrangement. Once the Tariff of 1869 was in place, they exploited the protected American market by dumping their surplus output on foreign markets at world prices, which were lower than the prices obtained at home. The principal Michigan producers, along with representatives of the Tennessee copper mines, Eastern smelters, and copper brokers, met at the Quincy office in New York City on March 1st, 1870, with W. R. Todd serving as Secretary, "for the purpose of devising some means whereby the price of Ingot Copper might be advanced above the present price."[18] They observed that domestic copper production was about 30 million pounds in 1869, but American demand was only about 24 million pounds and that:

> the results of this year's operation would probably not vary much from that of the year 1869 and that so long as this state of affairs continues the price of copper would gradually decline until it reach (sic) (the price) ruling abroad, say 15 cents per pound.[19]

They agreed to export at least 5.5 million pounds of the 1870 output and appointed a committee consisting of Mason, C. C. Douglass, and F. Heyne to develop a specific plan of action. The producers met again in Boston on March 10th and signed an agreement providing for a minimum export of 3.4 million pounds to be arranged by Mason, John Simpkins (Calumet and Hecla) and Elishan Loring (South Pewabic) in such a way to prevent the re-export of this copper back into the United States.[20]

This pooling arrangement was successful during the early 1870s. Exports of American copper were 8.5 and 9.3 million pounds respectively in 1870 and 1871, roughly one quarter of total American output. When domestic prices jumped from 24 cents in 1871 to 36 cents in 1872, American producers did not need to export to sustain high prices at home. In 1871-1873 domestic prices were between 5.2 and 9.4 cents per pound higher than world prices, attesting to the effectiveness of the pool and tariff combined. This price differential fell abruptly to 3.7 cents in 1874 and did not rise above 4 cents until the years 1879-1882, after which time the polling arrangement began to fall apart.[21] Had the industry not practiced extensive cooperative "dumping" abroad, it is likely that copper would have sold in the United States for less than the world price, making the Tariff of 1869 pointless. In the years 1870-1880, American copper producers exported nearly 94 million pounds or one-fifth of their total output. Although industry production doubled between 1870 and 1880, producers received the same price for copper in both years.[22]

Quincy was an active participant in these pooling arrangements and shared the benefits of relatively stable prices. This was not a restrictive arrangement which limited the output of Quincy and the other producers, but neither did it end severe price fluctuations altogether. The prices Quincy received for its copper peaked at 33 cents in 1872, then fell sharply and settled at between 21 and 23 cents in 1874-1876, reached a low of 17 cents in 1878 before recovering to 21 cents in 1880. Still, if we could exclude the boom of 1872-1873, prices were reasonably stable over the longer period of 1868-1882. The pooling system was manageable and effective because the Michigan producers accounted for three-quarters of U.S. output during these years and Calumet and Hecla produced about two-thirds of the Michigan total.[23] The Calumet and Hecla Mining Company made the system work because it was willing to limit its own production, thus sacrificing its short-run interests. This giant producer recognized that its long-term self-interest would be best served if the protective tariff remained effective and if the producers could avoid cut-throat competition among themselves.[24]

Ultimately, however, Quincy's prosperity was determined by how well it conducted its Michigan operations. Despite the changes at the Company's Eastern office, there was a stable management team in Michigan during the years 1872-1880. When James North Wright resigned as Agent in November 1872 he was replaced by Andrew J. Corey, who had served as Mine Clerk since November 1868. Daniel Kloeckner in turn replaced Corey as Mine Clerk and held that position for nearly twenty years. Corey was only twenty-six when he assumed the Agency and perhaps would have had a long tenure had he not died in February 1881 from "Bright's Kidney Disease" at the age of thirty-five.[25] The rest of the upper management team remained largely unchanged during Corey's tenure. Scheuermann, Cliff, and McCall held the key posts of Stamp Mill Superintendent, Mining Captain, and Surface Captain respectively. The Company retained only two Assistant Captains during the 1870s, with Edward Parnell filling one of these positions from July 1872 onwards.[26] The other was held by James Quinn until May 1876, when a piece of mass copper fell on him in the mine, crushed his leg, and ultimately cost him his life.[27] Thomas Denis, a longtime Pewabic Mining Company employee, replaced Quinn and served until November 1879, when he became Captain of the Franklin Mine.[28] He was in turn replaced by Thomas Whittle, a Cornishman who had worked for Quincy as a Timber Foremen since 1877. Whittle served as Assistant Captain until July 1882 when he became Captain of the Pewabic Mine.[29] Quincy continued to supply neighboring mines with managers as it had done in the 1860s.

Even with the best possible management, the mine was vulnerable to a variety of disruptions which could not always be anticipated, much less controlled. The epidemic of horse distemper which disrupted the mine's surface operations in November 1872 was only one of the many threats and crises that Corey had to face during the first few years he served as Agent.[30] The following Spring, the Pewabic and Houghton mines as well as several iron mines in Michigamme suffered major fires which forced them to shut down.[31] In a mild panic, Corey wrote to Todd, "Please order for us 400 feet (of) 2½ inch rubber hose for our Fire Engine. 1 find we have not enough on hand to make the Fire Engine available in case of fire at either Engine House."[32]

There was also considerable labor unrest at Quincy and throughout the copper district in 1872-1874, apparently the result of sharp rise in the cost of living, coupled with a general shortage of labor, especially miners. In April 1872 several hundred Calumet and Hecla miners struck, demanding a reduction of the workday fron ten to eight hours in addition to the substantial raise in pay (from $60 to $70 per month) already offered by the owners. There were threats of civil disorder in Calumet following the arrests of several strike leaders.[33] This unrest spread throughout the district and Quincy was forced to stop all underground operations for two weeks in May, although surface workers did not join the miners in striking.[34] The labor shortage and general unrest among the miners continued, even though the Company had increased wages substantially.[35] Corey reported that the Quincy miners were ready to strike in the Spring of 1873, but "easy" contracts in April and May had at least temporarily removed the threat.[36]

Labor problems continued even after the mines began experiencing severe financial difficulties in late 1873. Before Christmas, Corey reported:

> Rumors of strikes are again in circulation and I am led to believe the plot is deeper and more extensive than would be thought possible at a time when labor is much in excess of the demand. On Thursday calls for a strike on 1st January were posted at Calumet & Hecla and the Scandanavians have issued posters in their own language for a meeting for the same purpose tonight at Red Jacket. Beyond more rumors I cannot learn that any meetings have been held or that any understanding exists among our men.[37]

Since the miners were not in a particularly strong bargaining position, Corey suggested that should a strike actually begin, all the mine owners should "take a decided stand and suppress it at all hazards, even if it necessitates a stoppage of several months."[38] The miners struck Calumet and Hecla on New Years' Day, but they were divided and the effort collapsed within a week.[39] At Quincy and throughout the district, wage rates were adjusted downward, reflecting the new economic conditions.[40] There is no evidence of any further collective action on the part of miners or any other workers at Quincy until 1890.

Taken in its entirety, the 1870s were marginally more profitable for the Company than the 1860s. Quincy's overall performance, summarized in Table 3.1, could not have produced much enthusiasm. Although production was higher in the second half of the decade than in the first, profits fell off substantially in 1876-1879, although they did not sink to the dismal levels recorded in 1865-1868. Net profits were not significantly reduced by heavy investment in the mine's plant and equipment because investment was relatively small, accounting for more than one-tenth of gross profits in only three years--1872, 1873, and 1877. If one excludes 1872 and 1873, when copper prices and production costs escalated, Quincy was producing copper for 15 or 16 cents a pound in 1870-1875 and selling it for

22 or 23 cents, generating a typical profit of 6 or 7 cents a pound. Although the Company was able to reduce its production costs by 2 cents a pound in 1876-1879 (from 15.7 cents to 13.7 cents), copper prices fell even faster, reducing the average profit margin on a pound of copper to only 2.8 cents in these years.[41] The profit squeeze was the result of an unfavorable copper market and took place in spite of the Company's efforts to cut costs through the introduction of new technology.

The most important change in the Quincy's technology was the construction of a rock house in 1872, replacing the kilnhouse system for breaking rock used since the late 1850s. Quincy's first rock house and the new tramroad feeding it, including all machinery and equipment, required an investment of $58,474 in 1872-1873, one-third of the entire amount spent on permanent improvements in 1871-1879.[42] They were substituting capital for labor at a time of severe labor shortages in the district. The rockhouse and connecting tramroads not only reduced the cost of breaking the rock, but also lowered the overall costs of moving rock from the shafthouses to the Stamp Mill. Comparing 1871 with 1875, two years with similar copper prices and overall costs, the costs of sorting, breaking, and moving a ton of rock to the Stamp Mill fell from 53 cents to 38 cents, a reduction of more than one quarter. This represented a savings of about one-third of one cent per pound of ingot copper, which may not appear to be particularly significant. However, had the Company treated its 1875 volume of rock at the 1871 costs, they would have had to spend about $11,000 more than they actually did in 1875. A savings of $11,000 a year resulting from an investment costing roughly $58,000 suggests a reasonably wise decision on the part of

TABLE 3.1: QUINCY MINING COMPANY, INDICATORS OF AGGREGATE PERFORMANCE, 1871-1879

	Total Employment	Output of Copper (Tons)	Average Sale Price (Cents Per Pound)	Gross Profits	Permanent Investment	Net Profits	Dividends	Stock Quotations High	Stock Quotations Low
1871	440	1,205	24	$197,835	$ 3,458	$194,377	$260,000	$34	$20
1872	487	1,135	33	280,772	67,228	213,544	250,000	65	34
1873	489	1,311	27	243,961	35,492	208,469	160,000	54	26
1874	468	1,525	22	186,071	11,599	174,472	160,000	49	28
1875	504	1,399	23	232,216	15,251	216,965	160,000	46	35
1876	510	1,537	20	139,413	3,123	136,290	140,000	50	40
1877	474	1,360	19	116,178	22,468	93,710	100,000	50	39
1878	481	1,496	15	58,578	3,236	55,340	40,000	42	11
1879	490	1,320	16	80,027	4,485	75,542	120,000	34	10

SOURCE: QMC, Annual Reports, 1871-1879 and Lawton, Review, pp. 28, 30.

management.[43] The savings came from substituting steam-driven machinery for hand labor, which can be seen from the detailed breakdown of costs given in Table 3.2 below.

TABLE 3.2: COSTS OF ASSORTING, BREAKING, CALCINING AND RUNNING ROCK TO THE STAMP MILL, 1871 and 1875 (CENTS PER TON OF ROCK)

	Total Costs	Wages	Fuel and Materials
1871	53	47	6
1875	38	27	11

SOURCE: QMC, Annual Reports For 1871, 1875, p. 13.

At the same time the Company successfully adopted the rock house, they made an abortive effort to use compressed air drills underground. After spending nearly $27,000 in 1872-1873 on an air compressor and drills, they quickly abandoned the experiment.[44] They were more successful in using diamond drills for exploratory drilling, but this entailed spending only $1,500 in 1875 and $2,503 in 1877.[45] The investments in the rock house and in air drills cost slightly more than $38,000 out of the total of $166,000 spent on "permanent improvements" in 1871-1879. The other major investments included several additions to the man-engine ($18,140); a new engine, boiler, smokestack, shafthouse, and cistern at the Number Four Shaft ($17,249); a significant addition to the plant and equipment at the Stamp Mill ($16,052); and six new double tenement houses built in 1875-1876 for $9,233.[46] Of all of these investments, only those of 1872-1873 can be seen as essentially innovative. Virtually all of the remaining investments were unavoidable if the mine were to remain in operation and simply involved replacing existing equipment with something similar. Given the Company's financial position in the late 1870s, we should not be surprised by their conservatism.

The Air Drill and Expansion, 1880-1885

The technology used at the Quincy did not change in a fundamental way between 1860 and 1880. The new methods and machinery that were introduced --the use of wire rope and skips, the man-engine, and the rock house--were in most respects incidental and peripheral to the core of the Company's operations--separating the copper rock of the Pewabic Vein from the surrounding rock which encased it. Beginning in 1880, however, underground mining technology was fundamentally altered with the successful introduction of air drills. The immediate effects included a sharp increase in output, greater worker productivity, and a sharp rise in profits. As significant as these effects were, the second-order consequences or "ripple effects" were far more important to the Company over the long run. Air drills increased Quincy's potential for expansion significantly and created pressures for additional technological changes in virtually every major phase of the Company's Michigan operations. These developments set the stage for a series of radical changes which took place in the 1890s.

The Quincy's overall performance, summarized in Table 3.3, improved considerably beginning in 1880. The previous output record set in 1876 (1,537 tons) was surpassed by a wide margin in 1880 and in 1881 production climbed to a new plateau of about 2,900 tons, roughly doubling the output levels of the 1870s. While production was increasing, total employment remained approximately the same, but the number of miners fell by one quarter.

TABLE 3.3: QUINCY MINING COMPANY, INDICATORS OF AGGREGATE PERFORMANCE, 1879-1887

	Total Employment	Contract Miners	Output of Copper (Tons)	Average Sale Price (Cents Per Pound)	Gross Profits	Permanent Investment	Net Profits	Dividends	Stock Quotations High	Stock Quotations Low
1879	490	212	1,320	16	$ 80,027	$ 4,485	$ 75,542	$120,000	$34	$10
1880	492	192	1,805	21	389,569	42,415	347,154	300,000	46	22
1881	486	212	2,851	19	539,266	66,674	472,592	440,000	52	32
1882	439	152	2,841	19	511,973	63,428	448,554	440,000	70	40
1883	453	165	3,006	14	317,813	21,782	296,031	320,000	64	40
1884	427	157	2,840	12	241,238	23,790	217,448	200,000	48	26
1885	400	132	2,924	11	253,484	17,830	235,654	240,000	55	27
1886	415	140	2,944	11	243,396	27,615	215,781	240,000	65	45
1887	447	142	2,802	12	263,315	75,587	187,728	200,000	63	45

SOURCE: QMC, Annual Reports, 1879-1887 and Lawton, Review, pp. 28, 30.

Profits, dividends, and the price of Quincy stock also improved noticeably. Although copper prices were higher in 1880 and 1881 than they had been since 1877, they quickly declined to record low levels in 1883-1887. The Company nevertheless earned respectable profits throughout these years. A comparison of 1880 and 1887 (Table 3.4) shows that they achieved this result by reducing costs and earning a lower profit margin on a larger output.

TABLE 3.4: QUINCY COSTS AND PROFIT MARGINS, 1880, 1887 (IN CENTS PER POUND)

	Copper Output (Tons)	Total Operating Costs	Average Selling Price	Profit Per Pound of Copper	Gross Profits
1880	1,805	11.8¢	21.4¢	9.6¢	$389,569
1887	2,802	7.3	11.7	4.4	263,315

SOURCE: QMC, Annual Reports For 1880, 1887 and Lawton, Review, p. 28.

There was a dramatic increase in copper output and in the productivity of miners associated with the introduction of air drills in 1879-1881.[47] It is difficult to isolate the impact of air drills because other significant changes were taking place at the same time and some of these were partially, but not entirely the result of the use of the air drill. There are no readily comparable years during this transition, so I have chosen to compare 1877 with 1882, solely on the grounds that copper prices were nearly identical in both years. Table 3.5 summarizes the available data on physical productivity in mining in 1877 and 1882.

In addition to increasing the volume of rock excavated, the Company significantly reduced the wasteful production of "poor rock," the rock which was mined but was too poor to send to the Stamp Mill. The share of poor rock fell by one-third, from 24 percent of the total in 1877 to 16 percent by 1882. The yield of ingot copper from the Mineral produced by the Stamp Mill was roughly the same in both years, 82.2 and 82.7 percent respectively. The difficulty comes in determining why there was a substantial increase in the ingot copper recovered from each ton of rock treated. The equipment at the Stamp Mill was significantly enlarged and upgraded in 1877 and 1881-1882, cutting down the losses of copper substantially.[48] Improved Stamp Mill efficiency must have accounted for some of the increase in copper recovered from a ton of rock, but the proportion oannot be determined.

Beginning in 1864, the Company calculated the "yield of ingot copper per fathom of ground broken" as an overall indicator of mining performance. ("Yield per fathom" is used throughout this chapter for the sake of brevity.) In years 1864-1880, this figure varied from 391 pounds in 1872 to 577 pounds in 1874, with an average of 481 pounds for the entire period. Annual fluctuations as high as thirty percent were not uncommon, but there was no discernable trend before 1881, when there was a drastic increase to 767, 800, and 850 pounds in 1881, 1882, and 1883 respectively. This was not simply a short-run aberration, for the average yield per fathom was 742 pounds for the 1881-1890, an increase of 54 percent over the average for 1864-1880.[49] The annual and trend variations in yield could have been the results of variations in Stamp Mill efficiency, the richness of the vein, or the way in which underground mining was conducted. Each source will be considered in turn.

TABLE 3.5: PHYSICAL PRODUCTIVITY AT THE QUINCY MINE, 1877 and 1882

	Copper Output (Tons)	Rock Mined (Tons	Rock Hoisted (Tons)	Rock Treated At Stamp Mill (Tons)	As Share Of Rock Mined (%)	Ingot Copper Per Ton Of Rock Treated (Lbs.)	Ingot Copper Per Ton Of Rock Mined (lbs.)
1877	1,360	98,916	81,587	75,307	76	36	27
1882	2,848	120,377	109,751	101,377	84	56	47
Percent Change	109	22	34	35	11	56	74

SOURCE: QMC, Annual Reports for 1877, 1882.

There is no reason to believe that changes in Stamp Mill operations could account for the often-violent annual variations in yield per fathom. The copper content of the mineral produced by the mill did not change much from year to year and there is no other evidence that Stamp Mill efficiency changed much once a given technology was in place there. Nor is it likely that the improved equipment installed at the mill in the late 1870s produced these drastic changes. The basic technology in use (gravity stamps) remained the same and the Annual Reports and correspondence from the period suggest that the improvements in efficiency at the Stamp Mill were significant, but not enormous.[50] It is unlikely that changes in Stamp Mill operations accounted for more than a ten percent increase in the amount of copper extracted from a ton of rock.

Perhaps the portion of the Pewabic Lode worked in the early 1880s was simply much richer than at any other time in its development. The lode could be "richer" in two distinct senses--there could be more copper-bearing ground along a given length of drifts, or the pockets of copper rock could have a higher copper content. The fact that the copper content of the rock treated at the Stamp Mill jumped from roughly 2 to 3 percent does not prove that the average copper content of the rock found underground was higher, but only that higher quality rock reached the Stamp Mill.

There is simply no direct, independent measure of the overall quality of the rock found underground during these years. One might use the available figures on mass copper as a proxy for the richness of the lode, but this has several pitfalls. Quincy managers and miners alike would have preferred to find large pockets of amygdaloidal rock of high (over 3 percent) copper content, heavily laced with "barrel work" in combination with no mass copper, because the later was a mixed blessing at best. More important, there was generally a negative correlation during the 1870s and 1880s between these two indicators of "richness"--the share of mass copper in total output and the yield of copper per fathom broken. The lowest yield (391 pounds) and the highest share of mass copper in total output (8.8%) of the 1870s occurred in the same year, 1872. Similarly, in the early 1880s, when the yield per fathom jumped from 767 pounds in 1881 to a peak of 850 pounds in 1883, the proportion of mass copper in total output fell from 10.9% to 3.4%.[51] It may have been the case that when the amygdaloidal rock was very rich, the Company delayed cutting up the masses where possible. In any case, mass copper is simply not a good proxy for the richness of the lode.

This question is complicated by the fact that the yield of ingot copper per fathom could increase independently of the richness of the lode. This could happen if the miners concentrated on stoping to the exclusion of relatively unproductive developmental work, like shaft-sinking, drifting, and cross-cutting. Every team of miners transferred from development work to stoping would raise the average yield per fathom. The yield could also be increased if the Captains were more selective in choosing the areas to be stoped out. All of the copper-bearing rock found underground was not equally rich, nor was there always a compelling reason to stope it all out at once. The copper yield of each fathom broken could be increased substantially by mining more selectively, while the lode itself could actually be declining in overall richness. What was the source of this large, long-run increase in the amount of ingot copper produced for each fathom of ground broken--proportionately more stoping, richer ground, or more selective stoping?

The Company's Annual Reports prior to 1878 contain sufficiently detailed information to adequately address this question, but even the relatively complete data from the 1870s pose as many questions as they answer. The stoping portion of total ground broken varied from about 81 percent to 89 percent in 1870-1877, but as this share rose, the yield of ingot copper fell, an unexpected result. Perhaps the Company would shift miners away from developmental work to stoping when the quality of the rock was falling in order to assure some minimal level of total output. This may have been done when shaft-sinking or drifting was proceeding through unusually barren ground. During these years at least, shifting miners into stoping was associated with falling yields per fathom. There was an increased emphasis on developmental work beginning in 1874 (Table 3.6).

TABLE 3.6: QUINCY UNDERGROUND OPERATIONS, 1870-1877

	Total Ground Broken (Fathoms)	Total Ground Stoped (Fathoms)	Stoping As A Share of Total Ground Broken (%)	Average Yield of Ingot Copper Per Fathom of Ground Broken (Lbs.)
1870-1873	21,750	19,079	87.7	463
1874-1877	22,887	18,847	82.3	509

SOURCE: QMC, Annual Reports For 1870-1877, passim.

The Company concentrated on developmental work, especially drifting in the late 1870s in large part to avoid having to purchase new hoisting equipment to reach the new depths.[52] Taken in isolation, then, shifts in the emphasis on stoping do not appear to account for changes in the yield per fathom.

There are even more complex interrelationships between the development of the mine and yields. On the one hand, if development is being pushed well ahead of stoping, then the Captain can afford the luxury of letting contracts for only the richest ground, thus raising the yield per fathom although the overall quality of the rock may not change. On the other hand, if the richness of the lode is indeed improving substantially, then the Company can afford to emphasize developmental work, in effect converting the good fortune of today into an investment in the mine's future. Untangling these interrelationships is difficult for the years prior to 1877 and nearly impossible for the critical period when air drills were introduced.

The Annual Reports for 1880-1882 contain many references to discoveries of large and unusually rich pockets of good stamp rock heavily laced with barrel work and mass copper, suggesting that the lode had become substantially richer. However, there is also considerable evidence that the amount of drifting increased significantly as well and that air drills were used to push development to the point of increasing the known reserves of copper.[53] They were finding more copper, but they were also drifting a lot more than before. The Company was forced to practice more selective mining during the early 1880s because the Stamp Mill could not handle the additional volumes or rock which could be mined with the air drill. In his report for 1881, Frank White explicitly discussed this problem:

> The mine is equal to supplying a large quantity of low grade rock in addition of what is now treated, and which should be mined and milled with the higher grades which have been stamped during the past two years; but the mill having been worked to its full capacity, no increased duty was possible.[54]

More selective mining was at least partially responsible for the tremendous increase in the richness of the rock sent to the Stamp Mill in the early 1880s. The rock was richer and they were simultaneously practicing more selective mining.

We can now examine more closely the changes in operating costs at Quincy between 1877 and 1882, summarized in Table 3.7 below. The doubling in the amount of ground excavated per miner must be attributed to the air drill. This increase in physical productivity was only partially offset by a smaller rise in wages, so wage costs per fathom fell by slightly less than half. The simultaneous (and related) rise in the yield of ingot copper per fathom combined to produce an enormous increase in the ingot copper produced by each miner and a two-thirds reduction in the wage costs for a pound of copper. Directly and indirectly, the air drill probably accounted for about two-thirds of this total reduction in wage costs. Had the 1882 Quincy output been produced without the benefit of the savings brought by the air drill, total operating costs would have been roughly $100,000 higher in 1882 than they actually were, an increase of about one-fifth.

Given the revolutionary impact of air drills on output, costs, and profits, it is not surprising that investment in "permanent improvements" increased sharply in the early 1880s and that much of this investment was related to the air drill. The overall level of investment rose from an annual average of $9,712 in 1875-1879 to $39,319 in 1880-1885 and a whopping $57,505 for 1880-1882. The air drill accounted for about half of the total investment of nearly $236,000 in 1880-1885. The Company spent only $10,070 for the purchase of air drills, but $37,383 for air compressors and $61,214 for new boilers and related structures. It can be argued, however, that several other major investments were also the result of the increased production brought about by the air drill, including the replacement of the shafthouse and hoisting engine at the Number Two Shaft ($30,306) and the

TABLE 3.7: QUINCY MINING COSTS, 1877 and 1882

	Output of Copper (Tons)	Total Operating Costs, Per Pound of Copper (Cents)	Average Selling Price of Copper (Cents Per Pound)	Number of Contract Miners	Total Fathoms Broken	Fathoms Broken Per Contract Miner	Average Monthly Wages of Contract Miners	Wages Per Fathom Broken	Ingot Copper Per Fathom (Lbs.)	Ingot Copper Per Miner (Tons)	Wages Per Pound of Copper
1877	1,360	13.8	19.0	249	5,817	23.4	$43.79	$22.40	467	5.46	4.8¢
1882	2,841	8.4	19.1	152	7,087	46.6	48.83	12.56	800	18.69	1.6
Percent Change	109	-38	--	-39	22	100	11	-44	71	242	-66

SOURCE: QMC, Annual Reports For 1877, 1882.

installation of a Sand Wheel at the Stamp Mill ($9,863). Other expenditures such as the $22,000 spent in 1880 to replace the rock house lost by fire and a series of extensions to the Quincy Dock totaling nearly $23,000 cannot be linked directly to the air drill. Nor can the enormous expenditure, uncharacteristic of Quincy, of $24,199 for a new Agent's house in 1880-1882.[55] The decision to build this elaborate residence was symbolic of the Company's confidence in its future at the beginning of the new decade. Perhaps it is only a coincidence that they elected to begin building this imposing structure in the same year the Rand air drills had proven their worth.

Quincy in the 1880s: Management and Labor

In addition to the introduction of the air drill, the early part of the decade was marked by one last stockholders' revolt against Mason and several changes in management at the mine. Mason's problems with Quincy's Boston stockholders did not entirely end after the Company had established a Transfer Office there in 1880. For reasons which are not clear, the Quincy Directors met periodically in Boston in 1883, while in the second half of 1884, all of the meetings were held there.[56] Nathan Daniels, who ran the Transfer Office, was an ally of Mason's and apparently served as his observer, watching the Boston Stock Market and Quincy's Boston shareholders as well. The Company was a victim of stock market speculators who spread false rumors about the condition of the mine in order to depress the price of the stock. In a long letter to Harris in September 1884, Daniels complained that

> The price of Quincy has gone to the dogs and all the old lies are reviving to keep it down - "it's badly managed" - "it's petered out" - "Office ought to be in Boston" and so on, almost without limit, but the mine will survive it all and we must await with patience the turning of the tide, which will come by and by.[57]

In February 1885 several Boston newspapers carried rumors that the Quincy was proving barren at the 33rd level and the mine would soon shut down. Daniels was naturally alarmed:

> Of course the statements are making our stockholders more or less uneasy and I should be glad if you would give me just the situation there at the 33rd level, No. 2 shaft as soon as convenient, as payment of a dividend is coming on and I shall see the stockholders face to face and (will) have their inquiries to answer.[58]

These unidentified speculators were apparently successful because Quincy stock prices (Table 3.3) declined abruptly in 1884 and 1885.

The old feud between the Boston and New York stockholders erupted again in 1885. Since the return of the Company office to New York in 1875, the five-member board of Directors had consisted of two major stockholders from New York, two from Boston, and the Agent, who could seldom attend meetings and would vote with Mason anyways. The best result the Boston stockholders could achieve was a deadlocked Board.[59] The immediate problem was the size of the dividend to be paid on August 1st, 1885, but the underlying issues were the location of the Company's office and Mason's control. The New York Directors proposed a dividend of $1.50 per share, while the Boston Directors wanted $2.50 a share. The deadlocked Board compromised on $2.00, but the Boston interests were in open revolt against Mason, who initially sent Todd to Boston to try to placate them and then made several hurried trips himself.[60] In a confidential letter to Mason, Daniels explained how serious the discontent was:

> Mr. Brown is, I am sorry to say, much disturbed today by the failure to vote a dividend of two dollars and a half. He has written you a letter which you will probably receive with this. I hope he will be calmer tomorrow. I have not seen Mr. Rice today. I am very sorry to have him feel so (angry), and the condition at the moment is serious, requiring patience and prudence. In your reply to-him, strive to pour a little oil on the troubled waters, but in correspondence to me at the office don't mention this subject but address all such (letters) to my house, 13 Joy Street.[61]

The motives of Mason and Todd were questioned in Boston and one shareholder suggested that Mason was the party trying to depress the price of Quincy stock:

> It is thought that Mr. Mason has sold his (Quincy) stock largely and is now wanting to buy & that is the object of his move; that has never been my policy, to make a move to compel or frighten people to sell their (Quincy) stock, enabling those who purchase to get it at a low price. Have the kindness to inform me confidentially (of) the amount of Stock held by your large New York stockholders.[62]

In a long article on the controversy which appeared in the Boston Courier on August 2nd, it was argued that Quincy should move its office back to Boston to permit the majority of the stockholders to run the Company and to save money.[63] The anonymous "reporter" observed:

> Now it looks to a disinterested outsider as though this farce of "talking" about a removal of the Quincy office has been played for all its worth. It is well known that the dividend on more than three-quarters of the stock is paid in Boston, so that the control of the stock is here largely, and if Boston people have any pluck and mean business, why not go to work man-fashion and bring the office here from whence it was taken some years since by trickery. If this is not done and done promptly, the Boston management should forever keep the peace.[64]

Mason must have pacified the Boston interests once again, but exactly how he did this is not clear.

Developments at the mine were less explosive, but probably more significant. Corey's unexpected death in February 1881 was a serious loss for the Company and in recognition of his long years of service, the Directors agreed to pay his widow his full salary until May 1st. They immediately hired Frank G. White, the Agent of the Osceola Mine to fill the position.[65] White had first come to the Michigan copper district in 1854 and had held various managerial posts at the Clifton, Minnesota, and the Calumet and Hecla mines before taking the Agency of the Osceola.[66] He was forty-seven when he accepted the Quincy post. The Directors and Mason were pleased with White's performance, for they soon gave him a two year contract running until the end of this term, making his tenure one of the shortest of all the Agents. His letter of resignation and the other records give no explanation for his decision to leave the post.[68]

White's departure marked the beginning of a new era at Quincy, for his replacement, Samuel B. Harris, served as Agent from 1884 until 1902, a critical period in the Company's history. Harris was forty-nine when he accepted the post, with considerable experience as a miner and manager. Born in Cornwall in 1834, he came to the United States in 1854 and initially worked in the Wisconsin lead-mining district. He then came to the Michigan copper district in 1856, worked at the Minnesota Mine, and in 1864 became the Captain at the Pontiac and Mesnard mines. In 1866-1871, Harris served as Agent at the Eagle Harbor Mine, Assistant Captain at Calumet and Hecla, and as Captain at the Franklin. In 1871-1883, he was the Agent for a group of mines (Ridge, Adventure, Hilton, and Lake Superior) which were jointly owned and managed.[69]

Harris was always addressed as "Captain" and was the only native-born Cornish miner to hold the post of Agent at Quincy.

While there were important replacements in the top management positions at the mine during the 1880s, the overall organization of the Michigan operations had not changed significantly since the mid-1860s. The workforce was fifty percent smaller in 1885 than in 1865, but the mix of jobs and skills was roughly the same in both years. The labor force was divided about equally between underground and aboveground work and nearly half the workers had clearly identifiable skills. The distribution of the labor force, summarized in Table 3.8, reveals how little the occupational mix changed between 1865 and 1885 as a result of technological change. There were fourteen positions not delineated twenty years earlier, involving a total of seventy-three individuals, but many of these occupations (mason, plasterer, cooper, janitor, supply clerk, and scale attendent) were probably performed by someone in 1865, but simply not identified as such in the accounts. The same was true for trammers, but it is significant that the Company now recognized them as a distinct class of laborers. There were only four new occupations (thirteen men) resulting directly from the use of air drills and the diamond drill. The most significant change since 1865 was the replacement of fifty kilnhouse workers (including bosses) by nineteen workers at the rockhouse. In the interim, the volume of rock treated had doubled.

The ethnic composition of the Quincy workforce (Table 3.9) was not radically changed from twenty years earlier. Cornish, German, and Irish surnames were still dominant, but these workers were increasingly native-born Americans, since there had been no major wave of new migration since

TABLE 3.8: QUINCY MINING COMPANY LABOR FORCE, JUNE 1885

Number of Men	Position	Monthly Wages
1	Agent	$388
1	Mine Clerk	135
1	Assistant Clerk	63
1	*Supply Clerk	90
1	Physician	225
	Underground Mining	
1	Mining Captain	263
2	Assistant Captain	90
1	Timberman	47
40	Miner on Company Account	34-49
92	Miner on Contract	44
7	*Rand Drill Helper	21
2	*Diamond Drill Operator	27-44
48	*Trammer	36-41
22	General Laborer	22-40
	Surface	
1	Surface Superintendent	122
1	Surface Labor Boss	52
32	General Laborer	15-41
1	Assorting Boss (rockhouse)	60
14	Assorter & Breaker (rockhouse)	32-34
1	Tramroad Labor Boss	47
9	Tramroad Laborer	36-38
1	Boss Carpenter	100
8	Carpenter	45-59
1	Boss Blacksmith	77
8	Blacksmith	35-54
1	Boss Machinist	101
8	Machinist	32-59
2	*Rockhouse Engineer	41
2	*Rockhouse Brakeman	36
4	Engineer at Hoisting Engine	47
6	Fireman at Boilers	41

(Continued)

TABLE 3.8: QUINCY MINING COMPANY LABOR FORCE, JUNE 1885 (Continued)

Number of Men	Position	Monthly Wages
	Surface (continued)	
2	*Mason	$40-78
2	*Air Compressor Operator	36
2	*Rand Drill Repairman	52
1	Dock Boss	90
2	Dock Laborer	39-47
2	Change House Attendent	31
1	*Janitor	5
1	*Cooper	45
1	*Scale Attendent	36
1	*Assayer	22
1	Watchman	45
	Stamp Mill	
1	Superintendent	122
1	Boss Washer	55
31	Washer	13-38
11	Stamp Tender	33
1	Tail Wash House Boss	50
3	Tail Wash House Laborer	30
1	Boss Machinist	90
4	Machinist	33-60
1	Boss Carpenter	65
4	Carpenter	26-55
2	Blacksmith	36-55
2	Engineer	47
3	Fireman	38
1	*Plasterer	65
1	Watchman	42
1	Surface Laborer	36
2	Spare Hand	33
2	Wood Passer	33
1	Stamp Repairer	39

*Positions not delineated in June 1865.

SOURCE: QMC, Payroll Records, June 1885.

1865. The Finns began to appear in appreciable numbers at Quincy and throughout the copper district in the mid-1880s, along with other new groups, particularly the Poles, Swedes, Norwegians, and Italians. At Quincy and elsewhere the new immigrants tended to come from non-mining backgrounds, often from poor farming districts, were less skilled and less literate than earlier migrants, and usually took the poorest paid and least desirable jobs at the mines.

The labor force at Quincy was not radically different from that of the district as a whole. In 1888, the Michigan Bureau of Industrial and Labor Statistics conducted an extensive study of the workers of the copper district, surveying 3,070 men at a time when there were a total of about 6,000 mine employees in the district.[70] The major ethnic groups are summarized in Table 3.10 below. It should be noted that almost all the Canadians were French, most of the English were Cornish, and many of the Swedes and Norwegians were really Finns who had left Finland earlier to live in Sweden and Norway, but had retained the Finnish language and culture. Most of the "Americans" were the first generation produced by the immigrants of the Civil War era.[71] There were also sharp distinctions between the major ethnic groups in terms of how long they had been in the United States as of 1888.[72] The workers in Michigan's copper mines were becoming ethnically more diverse by the late 1880s and the Quincy labor force was no exception to the general rule.

The Late 1880s: Pressures, Problems, and Prospects

The immediate impact of the air drill was a doubling of output and a significant reduction in mining costs. At the same time, however, the

TABLE 3.9: QUINCY MINING COMPANY EMPLOYMENT, BY NATIONAL ORIGINS, JUNE 1885

	Cornish	German	Irish	English/ Scottish	Finnish	Canadian	Total
Contract Miners	NA	NA	NA	NA	NA	NA	92
Other Miners and Diamond Drill	37	2	5	--	3	2	49
Trammers	13	6	13	--	15	1	48
Underground Labor	11	2	7	1	1	--	22
General Surface Labor	24	14	10	6	7	6	67
Skilled Surface Labor	21	13	--	2	1	5	42
Stamp Mill-General Labor	13	28	7	2	--	3	53
Stamp Mill-Skilled Labor	4	13	--	--	2	--	19
Administration	6	1	2	2	--	--	11
Total	129	79	44	13	29	17	403

SOURCE: QMC, Payroll Accounts, June 1885.

TABLE 3.10: NATIONALITY OF MICHIGAN COPPER MINING EMPLOYEES, BY PLACE OF BIRTH, 1888

Americans	631
English	652
Finlanders	386
Canadians	330
Germans	221
Irish	210
Austrians	156
Polanders	120
Swedes	104
Norwegians	103
Italians	61
Scotchmen	51
Others	45
TOTAL	3,070

SOURCE: Michigan Bureau of Labor and Industrial Statistics, Sixth Annual Report, February 1, 1889 (Lansing, 1889), p. 91.

air drill created immediate pressures on the rest of the system of technology to process the larger volume of rock. More importantly, it became clear that if the enormous potential output which the air drill made possible was to be realized, then the entire system of technology would have to be altered. Quincy probably could have quadrupled its production of copper in the 1880s were it not for the severe constraints imposed by the rest of the technological system. The potential for even greater expansion was also limited because Quincy owned only part of the Pewabic Lode. In 1884, the Company purchased the adjoining Pewabic Mining Company properties, but was not able to occupy this territory until 1891 because of extensive litigation. In the interim, however, and certainly by 1888, Quincy was so confident of winning the legal contests that the Company was behaving as if it was already occupying the Pewabic lands. This section will consider the production constraints of the 1880s and this chapter will end with an examination of the entire Pewabic case, while the fundamental transformation of the technological system will be considered in the next chapter.

Hoisting capacity became a major bottleneck to increased production once air drills came into common use and the Company made a series of moves in the 1880s to eliminate this problem. They introduced larger skips, enlarged the two shafts in use to take a second set of skip tracks, straightened the Number Four Shaft, replaced the iron skip rails with steel ones, and significantly increased the capacity of both hoists.[73] Many of these improvements were made in anticipation of a large increase in output which would only be possible when all the major elements of the technological system were transformed.

The materials handling system for moving rock to the mill, as well as the transportation system used to move material to the mine, also came under increasing pressure in the early 1880s. White reported in 1882 that they had reduced the grades on a wagon road running from Reservation Street in Hancock up to the mine in order to reduce their freight charges.[74] Harris became increasingly concerned over the difficulty and expense of moving coal and other freight from the Quincy Dock on Portage Lake up to the mine. In 1884 and 1885, he proposed several possible solutions to this bottleneck--extending the existing tramroad from the Stamp Mill to the Quincy Dock; constructing a second tramroad directly from the mine to the dock; and signing a long-term agreement with the Mineral Range Railroad so that they would build a branch line to the mine.[75] The Mineral Range finally agreed to build this new line, which was completed in the summer of 1886 and terminated at Quincy's central boilerhouse.[76] Even with that improvement, they nevertheless had to rebuild the tramroad in 1887 at a cost of $14,760.[77] The transportation network was an important consideration in several other major decisions that the Company had to make during these years--the choice of fuel in all their operations and, more significantly, the fate of the Stamp Mill.

Fuel was a major expense for Quincy and the choice of fuel - cordwood versus coal - was a issue which was not resolved until the mid-1880s. Fuel was needed to produce steam for the engines used to drive the hoists, pumps, man-engine, rockhouse crushers, air compressors, and the machinery at the Stamp Mill. Prior to 1872, cordwood was needed rockhouse crushers, air compressors, and the machinery at the Stamp Mill. Prior to 1872, cordwood was needed for the kilnhouses and for the entire nineteenth century additional fuel was required to heat the Stamp Mill, dryhouses, office, and other mine buildings in addition to the homes of most employees. In the 1860s and 1870s, they relied almost entirely on cordwood, consuming enormous quantities. The mine alone used 4,050 cord in 1870, with the hoisting engines using three-quarters of the total and the kilnhouses most of the rest.[78] The Stamp Mill burned 4,993 cord in the same year, making total consumption of roughly 9,000 cord. Since Quincy was paying about $3.50 a cord at the time, fuel alone cost about $30,000 or roughly ten percent of their total operating expenses.[79] The Company also purchased an average of 200 tons of coal per year in 1861-1870, typically paying between $13 and $20 per ton.[80] Most of the coal was probably used in the blacksmiths' forges. The Quincy management generally assumed a ton of coal to be equivalent (in heat produced) to about two cord of wood, so the coal used in the 1860s was less than five percent of total fuel consumption. Coal was still too expensive to compete seriously with cordwood for general use.

With the introduction of the rockhouse and more powerful hoists in the 1870s, fuel use at the mine increased substantially. By 1880, consumption had reached about 15,000 cord and the total fuel bill was over $61,000 or nearly 17 percent of their operating costs.[81] The growth of fuel consumption and costs was further accelerated by the general expansion of output in the early 1880s, the price of coal had fallen significantly relative to wood, making coal a clear choice once transportation wrinkles could be ironed out. In early 1884, Nathan Daniels urged Harris to convert to coal at the Stamp Mill, arguing that he could immediately reduce fuel costs there by more than one-third.[86]

The move to coal was made cautiously, perhaps in part to force the Mineral Range Railroad to offer favorable terms to Quincy for building its branch line to the mine. In January 1885 Harris argued that they should burn either wood or coal exclusively and not try to mix them because of the modifications required in the boilers. He suggested that they exhaust their wood reserves before converting and had already contracted for another 7,000 cord for the Stamp Mill, to be delivered in the summer of 1885.[87] Once the Mineral Range Railroad opened its new line to the mine in the summer of 1886, the Company quickly switched over (Table 3.11), probably just in time to avoid serious fuel shortages. However, the conversion to coal did not entirely eliminate the use of wood in some appli-

TABLE 3.11: QUINCY PURCHASES OF CORDWOOD AND COAL, 1882-1889

	Cordwood (Cords)	Coal (Tons)
1882	19,702	NA
1883	17,710	NA
1884	23,162	NA
1885	17,301	488
1886	14,901	2,004
1887	5,788	4,926
1888	5,506	4,274
1889	5,205	10,655

SOURCE: QMC, Invoice Books, 1882-1889.

cations. The (new) Stamp Mill consumed nearly 4,000 cord of wood in 1893, probably to heat the buildings, but there were an additional 6,382 cord charged against "Hoisting Expenses" in the same year.[88] It is not clear where and how this wood was consumed, much less the rationale for using it instead of coal.

The question of fuel and the other bottlenecks at the mine were relatively minor compared to the problems created by the inability of the Quincy Stamp Mill on Portage Lake to handle the increases in output made possible by the air drill. During the 1880s the Stamp Mill was strangling the growth of the Company and once this bottleneck was removed in 1890, production exploded.

When it opened in 1860, the Stamp Mill was equipped with 64 head of gravity stamps, and this kind of stamping machinery remained in use for the three decades the plant operated. However in 1868-1869 and in 1877, the Company installed improved washing machinery for treating the mineral coming from the stamps, increasing the mill's efficiency in terms of recovering copper from the rock.[89] The mill was treating about 50,000 tons of rock per annum in 1863-1868, but then output slowly climbed to 75,000 tons by 1877. The new washing machines and other equipment installed in 1877 made it possible for the mill to treat about 90,000 tons in 1878 and 1879.[90] Although the number, size, and type of stamps remained unchanged, mill capacity had increased considerably. In 1880 the Company installed 16 additional gravity stamps in the mill, bringing the total to 80. The immediate impact was another increase in output, to about 100,000 tons in 1881-1884 and then a gradual rise to a record tonnage of 117,785 in 1889.[91]

By the mid-1880s the Stamp Mill was approaching its capacity at a time when the Company could easily contemplate doubling or tripling output. The mill had a series of fundamental problems which could no longer be solved with additions or minor modifications. There was no room at the Portage Lake site for expanding the plant and more significantly, there was no room to handle and store the increasing volume of waste sands. The gravity stamps in use there were obsolete and inefficient, at least in terms of the cost of stamping a ton of rock.[92] Finally, the passage of the Federal River and Harbor Act of 1886, which established harbor lines and prohibited the dumping of waste sands beyond these lines, forced the Company to look for a new mill site.[93] Mason and Harris considered a variety of options in 1885-1887, including the purchase of the Osceola Stamp Mill for $100,000. After they agreed on the necessity of building a new mill at a new site, they examined two locations on Quincy Hill and one at Dollar Bay, but finally decided to build the new plant at Torch Lake.[94]

The Company acquired the Torch Lake Mill Site in 1887 and began constructing the new plant the following year. Equipped with Allis steam stamps, it was treating 442,000 tons of rock by 1893, nearly four times the peak output of the old mill.[95] The Company simultaneously built a six mile long railroad, the Quincy and Torch Lake, to connect the mine directly with the new mill. It also built a large modern coal handling facility at the Torch Lake site, thus solving most of their transportation problems. These and other features of the "new Quincy" that emerged in the 1890s will be considered at length in the next chapter.

Finally, the air drill and the increased output it brought was one of several developments which tended to make the American copper market more competitive in the 1880s than in the previous decade. There were still periodic efforts to maintain pooling arrangements and the Calumet and Hecla Mining Company remained a strong advocate of restrictive practices, but Quincy and other mining companies became unenthusiastic and unreliable participants. The fundamental weakness of most of the pooling schemes of the 1880s was the failure of the Lake Superior companies to bring the new producers in the West into the pool. In 1868-1880, Michigan had accounted for between 80 and 95 percent of U.S. output and still had an 82 percent share in 1880. However, this quickly fell to only 44 percent by 1884 and then hovered around 40 percent at the end of the decade.[96] Acting alone, the Lake producers had lost much of their market power.

While pooling arrangements continued in the early part of the decade, the nature and effectiveness of the pool changed significantly. The one operating in 1882-1883, with Quincy participating, mainly served to increase the premium on Lake copper over other brands in the domestic market. Initially, Calumet and Hecla became the sole selling agent for Lake copper in the domestic market, but in the fall of 1884, this role was extended to include foreign sales as well. Because of quirks in the system, pool cooper was actually selling significantly below other Lake copper in both domestic and foreign markets in late 1884, prompting Quincy and others to (secretly) break the agreements.[97] In late November the Quincy Directors authorized Mason to sell up to 2,500 tons overseas, in his own name.[98] Calumet and Hecla tried to enforce the agreements through the Michigan courts, but Quincy successfully made the unselfish argument that the pool was against the public interest.[99] In January 1885, the pool quickly fell apart and the Quincy management was relieved:

> This morning the Quincy Company has (received) formal notice from the Calumet & Hecla Mining Co. that the 'Pool' is at an end. All the better for the Quincy as it puts its business again in its control.[100]

In another letter a few months later, Smith suggested that Calumet and Hecla had taken unfair advantage of its position in the pool by making secret sales of their own copper.[101]

There was a final effort to manipulate copper prices through a worldwide pool organized by M. Secretan and a group of French financiers. Quincy joined the Secretan Syndicate, which lasted from December 1887 until March 1889.[102]

Whether or not Quincy would have wanted to participate in any restrictive marketing arrangements once it occupied the adjoining Pewabic Mining Company property is a moot point. By the late 1880s, Quincy was poised to enlarge its production and was simply awaiting the resolution of the legally tangled Pewabic land purchase. I will conclude this chapter by considering this problem in detail.

The Pewabic Case

The Pewabic Mining Company, established in 1853, had discovered the Pewabic Lode in 1855, but was never as prosperous as her neighbors sharing the same deposit because of accidents of geography and geology. The lode ran from southwest to northeast and outcropped at the extreme northwest corner of the Pewabic Mining Company property (Section 25), but since the vein was inclined to the northwest as it went deeper, Pewabic quickly ran out of territory as it pursued the vein to greater depths. As early as 1859, Sam Hill noted that Pewabic's southernmost shaft would quickly intrude on Quincy's territory.[103] The Pewabic owners had hoped that their neighbors might help them solve their dilemma and they asked Quincy in March 1866 to consider exchanging some Quincy mineral rights for some Pewabic surface rights.[104] Later in the same year, they offered to work the northern end of Quincy's territory on tribute, using one of Pewabic's shafts for access. After some difficult negotiations in 1867, in which Quincy demanded $25,000 in cash for this privilege, the effort to reach an agreement was abandoned.[105]

By the late 1860s the Pewabic had taken most of the copper from within its original boundaries and production, which had averaged 825 tons in 1860-1867, fell to 480 tons by 1869.[106] They leased the Franklin Mine in 1870 and let both mines be worked by tributors for four years, during which time virtually all of the remaining copper was removed from the Pewabic.[107] The Pewabic Company was stymied again in 1875, when they were caught taking copper from under the southeast quarter of Section 23.[108] The land was owned by Mr. Edwards, who had bought it from the St. Mary's Canal Mineral Land Company for $25,000. The Pewabic management revived the mine by purchasing the property from Edwards in October 1879 for $275,000.[109] This land was valuable to them only because the Franklin Mining Company, located just north of the Pewabic, had previously given them mineral rights to the southwest corner of the Franklin property (Section 24), thus permitting the Pewabic Number Six Shaft to reach the southeast quarter of Section 23.[110] This was readily arranged because Pewabic and Franklin had the same owners at the time.

Quincy had expressed an interest in the same piece of property (Section 23) several years earlier, but had failed to buy it. In August 1873, Corey had recommended the purchase of the entire Section to Bigelow:

> I think we had better purchase from the Canal Company the Mineral right to the Pewabic lode on Sec. 23. . .If we can acquire this property now, for a reasonable sum, at no distant day, we can pick up the Pewabic property at a nominal figure. I do not consider this purchase as of any <u>immediate</u> benefit to us, but if we wait until we need it we may have to pay a larger price and run the risk of its being sold to other parties in the meantime.[111]

In March 1874 Quincy's Directors authorized Bigelow to negotiate the purchase of the property, but Bigelow failed to act until it was too late. The fact that he was also a Director of the Mineral Land Company may have been a major problem.[112] Corey's assessment of the property was entirely correct and Quincy's later difficulties in expanding stem in large part from their failure to buy Section 23 in 1874.

After the land purchase from Edwards, Pewabic's fortunes improved, with output climbing from 168 tons in 1879 to a peak of 938 tons in 1881, but then production fell off again as large portions of the mine proved barren.[113] In April 1882 the Pewabic Directors approached Quincy to discuss the possibility of a merger, but the Quincy Directors took no action.[114] Mason probably felt that time was on their side and that Quincy could acquire the Pewabic on better terms at some later time. The Pewabic management soon committed an incredible blunder by permitting their Charter of April 1853 to expire in 1883 without reorganizing the Company. The stockholders belatedly moved to establish the Pewabic Copper Company in 1884 and to transfer the assets from the old firm, but at that point the legal fireworks began, as Mason and his business partner, William Hart Smith, who jointly owned about one-eighth of the Pewabic stock, filed a suit to restrain the transfer and force the old Pewabic Mining Company to dissolve and liquidate its assets.[115] This marked the beginning of a series of legal actions which prevented the sale of the Pewabic property until 1891.

Mason saw the potential value of the Pewabic lands for Quincy and wanted to prevent the Pewabic and Franklin stockholders from "cooperating" to prevent Quincy from acquiring it, a likely outcome because of the interlocking ownership of the two firms. In April 1884, Mason asked Harris to assess the value of the Pewabic lands to Quincy. The Agent's lengthy reply is interesting in that he was skeptical about the value of the Pewabic mineral lands adjoining Quincy's, since the north end of Quincy was generally barren, but at the same time, he felt that the Pewabic Stamp Mill and tramroad would be valuable acquisitions.[116] Mason was clearly acting on Quincy's behalf and insiders like Daniels were delighted with these developments:

> At our office we say that there is no controversy between Quincy and Pewabic, but between the stockholders of Pewabic and its management, but that if a good nice plum is thrown at Quincy, they must not expect Quincy to kick it aside.[117]

However, the Company publicly (presumably with a straight face) maintained that Mason and Smith were simply independent businessmen acting on their own behalf.

Mason won the early legal skirmishes to have the Pewabic lands sold at public auction. In December, an elated Daniels wrote to Harris:

> I am happy of the continued success of Quincy and I should be happy after the 3rd of January next to be able to congratulate you on the consolidation of the Pewabic with Quincy, which (judging) from the sheriff's advertisements to sell the Pewabic that day, would seem to be among the possibilities.[118]

This celebration proved to be about six years premature. The sheriff's sale was delayed several times as the Pewabic stockholders, led by Daniel L. Demmon (Treasurer of the Franklin Mining Company) began a long series of appeals which ultimately reached the United States Supreme Court.[119] Smith and Mason took great pains in early 1885 to establish the legal fiction that they and not the Quincy Mining Company were buying the Pewabic property.[120] Justice Stanley Matthews of the U.S. Supreme Court agreed to hear the case of Mason and Smith versus the Pewabic Mining Company in early 1885 and by May he had ruled largely in favor of Mason and Smith. He was going to appoint Peter White as Special Master to liquidate the Pewabic Mining Company, but both sides had already decided to appeal the decision to the full Court.[121] The case was placed on the Supreme Court calendar in October, but with no chance that it would be heard before October 1888 at the earliest.[122]

The Supreme Court finally decided the case in Mason's favor in January 1890 and ordered the District Court to oversee the sale. Peter White was finally appointed Special Master to assess the Pewabic Mining Company's net worth and to liquidate all assets, which would then be distributed to the Pewabic stockholders.[123] He completed his work and set November 6th as the auction date, but the sale was delayed several times by legal challenges until January 24, 1891, when Mason and Smith finally purchased the property for $710,000.[124] This was not the end of the legal actions produced by the Pewabic matter, for it spawned several other major cases which were not entirely resolved until 1899.[125]

Mason and the other Quincy officers were less than happy with the obstructionist tactics used by Demmon and the Franklin Mining Company and became increasingly ill-tempered as the case dragged on. Once it became clear that Quincy had a victory within reach, Daniels offered a suggestion for getting even with the Franklin people:

> I note that the Pewabic has been kept pumped out so that the water should not run into Franklin. Now, when if ever you get it in charge, you might cease to pump and let the Franklin have the benefit of their own act of breaking into Pewabic (by) allowing the water to run over from Pewabic into Franklin, for which I do not see that they would have a remedy except to pump it out at their own expense. I would like to hear what Vivian has to say now. I suppose he may have said some "cuss" words out loud.[126]

The deed to the Pewabic property was finally transferred to Quincy on March 30, 1891 and Mason instructed Harris to proceed forthwith to make the long-planned renovations on the properties.[127] In early April Mason was still fearful of possible moves by Johnson Vivian, the Franklin Mining Company Agent, and therefore instructed Harris to occupy all the Pewabic lands to establish Quincy's authority over them:

> Have Dunstan and Hanchette (Quincy's attorneys in Hancock) direct you in this and make it preemptory that all tenants and occupants recognize your authority and not allow Vivian any chance to claim that he has any claim or authority in any matter whatever.[128]

Mason believed that Vivian would try to get a new trial and added, "now that we have got possession we must keep it, peaceably if we can and forceably if we must."[129] There was one last effort to get the U.S. Supreme Court to reconsider the case, but it failed.[130]

Mason and Smith had purchased the Pewabic property knowing that they would then immediately sell it to Quincy. At Mason's urging, the Quincy stockholders had voted at their Annual Meeting of June 5, 1889 to increase the capital stock of the Company from 40,000 to 50,000 shares and authorized the Directors to issue the new shares at their discretion.[131] It was understood that the increased stock would be needed to purchase the Pewabic lands from Mason and Smith once all the legal issues had been resolved. However, it is not clear that the stockholders would have approved the way in which Quincy paid for the property. Less than two weeks after Mason and Smith had the Pewabic deed in their hands, the Directors voted to exchange the 10,000 shares of stock for the Pewabic properties.[132] Mason and the Company officially maintained that Mason and Smith were paid $800,000 for the Pewabic lands, to cover the $710,000 auction price, plus $90,000 for legal and other expenses incurred over the previous seven years.[133] However, since Quincy stock sold for between $85 and $115 a share in 1891 and went even higher for the rest of the decade, the 10,000 shares were worth at least $1 million.[134] The leading Boston newspapers questioned the entire transaction, asking aloud if the Quincy Directors were acting in the best interest of the stockholders or to enrich Mason and Smith.[135] While the financial arrangements for the Pewabic lands can be questioned, the significance of the new property cannot. It was the cornerstone upon which Mason built a new Quincy in the late 1890s.

Notes

[1]QMC, Directors' Minutes, 1856-1878, p. 245.

[2]Ibid., Shareholders' Meeting of 6 March 1872. Two major stockholders, the Clark family (6,667 shares) and J. Prichard (4,032 shares) held an absolute majority of the total.

[3]Bigelow was heavily involved in dozens of Michigan mines in the late 1850s and 1860s. He was serving as Treasurer of the Allouez, Hancock, Hulbert, and Huron mines in 1865. See Gates, Michigan Copper, p. 34.

[4]QMC, Directors' Minutes, Directors' Meeting of 18 March 1872.

[5]Ibid., Directors' Meeting of 5 March 1873.

[6]QMC, Dividend Payment Lists, Dividend of 15 February 1872.

[7]Lawton, Review, p. 30. The Company typically declared a dividend in February or March, reflecting the earnings for the second half of the previous year, and a second dividend in July or August.

[8]Andrew J. Corey to W. R. Todd, 18 November, 25 November, and 3 December 1872.

[9]The Panic of 1873 began with the failure of several large Eastern banking houses in September, including Jay Cook and Company, followed by other business failures which continued into the late 1870s. Nationally, this was a period of declining prices. See Milton Friedman and Anna Jacobson Schwartz. A Monetary History of the United States, 1867-1960 (Princeton, 1963), pp. 42, 47, 56, 77-78.

[10]A. J. Corey to Horatio Bigelow, 7 November 1873.

[11]Lawton, Review, p. 28.

[12]QMC, Directors' Minutes, Directors' Meeting of 3 March 1875.

[13]Ibid., Directors' Meeting of 13 January 1879.

[14]Ibid., Directors' Meeting of 18 November 1880.

[15]QMC, Minutes of Shareholders' Meetings, Meeting of 6 March 1878.

[16]Lawton, Review, p. 28.

[17]QMC, Annual Report For 1877, p. 9.

[18]Minutes of Meeting of 1 March 1870 found in QMC, Directors' Minutes.

[19]Ibid.

[20]Agreement dated "Boston, March 10th, 1870," providing for the following contributions to the export pool:

Calumet and Hecla Mining Company	1,550,000	pounds
Baltimore Copper Company	500,000	"
Quincy Mining Company	300,000	"
Minnesota Mining Company	200,000	"
South Pewabic Mining Company	175,000	"
Union Consolidated Mining Company of Tennessee	150,000	"
Franklin Mining Company	150,000	"
Central Mining Company	150,000	"
Pewabic Mining Company	100,000	"
Schoolcraft Mining Company	50,000	"
Copper Falls Mining Company	50,000	"
Vermont Copper Mining Company	50,000	"
TOTAL	3,425,000	pounds

[21]The operation of this pool became increasingly complex over time. The two major students of this arrangement agree that the pool was most effective in 1870-1873 and 1879-1882. See Gates, Michigan Copper, pp. 46-54 and Orris C. Herfindahl, Copper Costs and Prices (Baltimore, 1959), pp. 70-72.

[22]Gates, Michigan Copper, pp. 47, 197, 203.

[23]Ibid., pp. 197-198, 230.

[24]Ibid., pp. 49-50.

[25]Houghton County, Record of Deaths I, 1867-1888, p. 134.

[26]A. J. Corey to E. F. Sutton, 11 June 1893.

[27]QMC, Annual Report For 1876, p. 21.

[28]Western Historical Company, History, p. 316.

[29]Ibid., p. 319.

[30]A. J. Corey to W. R. Todd, 18 November 1872.

[31]A. J. Corey to J. L. Gardiner, 25 June 1873.

[32]A. J. Corey to W. R. Todd, 17 June 1873.

[33]Rowe, Hard Rock Men, p. 167.

[34]QMC, Annual Report For 1872, p. 17.

[35]Average monthly wages for contract miners jumped from $47.08 in 1871 to $60.62 in 1872 and then to $62.92 for 1873.

[36]A. J. Corey to W. R. Todd, 11 June 1873.

[37]A. J. Corey to W. R. Todd, 20 December 1873.

[38]Ibid.

[39]A. J. Corey to W. R. Todd, 2 January and 7 January 1874.

[40]From $62.92 per month in 1873 to $48.38 per month in 1874.

[41]The average selling price for Quincy copper and the production costs are given in the Company's Annual Reports. They include the costs of permanent improvements in their calculations of production costs, which would distort the results if these investments were large, but they were relatively small in this period.

[42]QMC, Journal, 1871-1873, pp. 140, 316, 493; Journal, 1874-1876, pp. 147, 305, 480; Journal, 1879-1882, p. 65. The expenditures in 1872 and 1873 were as follows: Rock House and Breakers ($40,301); New Tramroad ($14,963); cistern at the Rock House ($1,289); and Drum House at the Trestle ($1,921).

[43]All of these cost comparisons for 1872 and 1875 are generated from the cost data given in the Annual Reports for those years.

[44]QMC, Journal, 1871-1873, pp. 316, 493. The abortive effort to use air drills in the early 1870s is considered in depth in Larry Lankton's report on mining technology.

[45]QMC, Annual Reports For 1875, 1877.

[46]QMC, Annual Reports, 1871-1879, passim.

[47]Quincy purchased one drill in July 1879, five more in June-September 1880, and twelve in 1881. By 1889, they had about twenty-five in service. The drills are discussed in more detail in Larry Lankton's report on mining technology.

[48]They installed improved washing machinery to reduce the copper lost in the waste sands. For a more detailed analysis of the Stamp Mill, see Charles F. O'Connell, Jr., "Quincy Pounds Its Rocks" Seventy Years at the Quincy Mills, 1860-1930," H.A.E.R. Report, 1978, passim.

[49]QMC, Annual Reports, 1864-1890.

[50]O'Connell, "Quincy Pounds Its Rocks," passim.

[51]QMC, Annual Reports, 1880-1883, passim.

[52]QMC, Annual Report For 1877, p. 15.

[53]QMC, Annual Report For 1882, pp. 11, 12.

[54]QMC, Annual Report For 1881, p. 13.

[55]QMC, Journal, 1879-1882, pp. 65, 303, 413; Journal, 1882-1887, pp. 32, 145, 253, 361, 482; Journal, 1887-1890, pp. 98, 215.

[56]QMC, Directors' Minutes, Directors' Meetings of 1883-1885, passim.

[57]Nathan Daniels to S. B. Harris, 9 September 1884.

[58]Ibid., 5 February 1885.

[59]The important Boston Directors included John Brown (1875-1891), Henry S. Ripley (1875-1880), B. F. Maservy (1880-1884), and Edwin Rice (1884-1896).

[60]Unsigned article, Boston Courier, 2 August 1885.

[61]Daniels to W. R. Todd, 23 July 1885.

[62]Confidential letter to W. R. Todd, 23 July 1885 on Quincy Mining Company letterhead. The signature is illegible, but appears to be Maservy's.

[64]Ibid.

[65]QMC, Directors' Minutes, Directors' Meeting of 2 March 1881.

[66]Robinson, "Early Days," p. 8.

[67]QMC, Directors' Minutes, Directors' Meeting of 20 January 1882.

[68]Frank G. White to Mason, 14 October 1883.

[69]Western Historical Company, History, p. 546.

[70]Michigan Bureau of Labor and Industrial Statistics, Sixth Annual Report, February 1, 1889 (Lansing, 1889), p. 91 and Gates, Michigan Copper, p. 209.

[71]The Sixth Annual Report includes all the answers given to the 46 questions asked by the surveyors. It includes data on work experience in the country of origin, housing information, and a variety of demographic data, all presented in a Table which is 138 pages in length.

[72]The Irish, German, Scots, and (French) Canadians had been in the United States an average of 19.3, 18.1, 15.8, and 12.4 years respectively. The new immigrants and the length of time they had been in the United States: Norwegians (8.0), Poles (7.8), Swedes (6.7), Finns (6.3), Italians (5.2), and Austrians (3.0). From Sixth Annual Report, p. 226.

[73]For a full discussion of these changes, see Larry Lankton's report on mining technology.

[74]QMC, Annual Report For 1882, p. 13.

[75]S. B. Harris to Mason, 18 December 1884 and 22 September 1885.

[76]QMC, Annual Report For 1886, p. 12.

[77]QMC, Journal, 1887-1890, p. 12.

[78]QMC, Surface Book, 1868-1870, pp. 108-117.

[79]QMC, Annual Report For 1870, pp. 6, 11.

[80]QMC, Invoice Books, 1861-1870, passim.

[81]The Company bought nearly 6,800 cord for use at the mine location in 1880, but we do not have any comparable figures for the Stamp Mill. Since the output at the mill was nearly fifty percent higher in 1880 than in 1870, perhaps the mill used about 7,000 cord in 1880, suggesting a total comparison of about 14,000 cord. This is probably an understatement because the Company had total fuel costs of $61,185 in 1880, suggesting about 15,000 cord at $4.00 each. The difficulty here is that we cannot assume that cordwood purchases are a good proxy for cordwood consumption and there are no data on inventories. See QMC, Supplies Used, 1876-1884 and Invoice Books, 1880, passim.

[82]Ibid.

[83]QMC, Annual Report For 1881, p. 13.

[84]Ibid., p. 12.

[85]QMC, Annual Report For 1882, p. 12.

[86]Nathan Daniels to S. B. Harris, 28 January 1884. Daniels argued that a cord of wood produced 45 percent of the heat generated by a ton of coal, yet cost $3.25 a cord compared to $4.50 a ton for coal. Using his figures Quincy could justify the continued use of wood only if it were selling for under $2.00 a cord.

[87]S. B. Harris to Mason, 19 January 1885.

[88]QMC, Cost Sheets, 1893.

[89]QMC, Annual Reports, 1868, p. 22 and 1888, p. 21.

[90]QMC, Annual Reports, 1861-1877, passim and Annual Report of the Commissioner of Mineral Statistics of the State of Michigan For 1881 (Lansing, 1882), p. 109.

[91]QMC, Annual Reports, 1881-1889, passim.

[92]The Quincy Stamp Mill was labelled "inefficient" and "outmoded" practically from the day it opened. These charges are discussed in depth in O'Connell. "Quincy Pounds Its Rocks."

[93]Mason to S. B. Harris, 14 May 1886.

[94]S. B. Harris to Mason, 7 February 1885, 16 May 1887, 23 May 1887, 13 June 1887, and 3 August 1887.

[95]QMC, Annual Report For 1893, p. 3.

[96]Gates, Michigan Copper, pp. 197-198.

[97]Ibid., pp. 50-52.

[98]QMC, Directors' Minutes, Directors' Meeting of 19 November 1884.

[99]Gates, Michigan Copper, p. 52.

[100]William Hart Smith to S. B. Harris, 10 January 1885.

[101]Ibid., 13 April 1885.

[102]Gates, Michigan Copper, pp. 78-80.

[103]Samuel W. Hill, "Longitudinal Section, Quincy Mine, November 16, 1859."

[104]Charles Emory to Mason, 3 March 1866.

[105]QMC, Directors' Minutes, Directors' Meetings of 12 December 1866, 27 February 1867, 21 May 1867, and 4 February 1868.

[106]Pewabic Mining Company, Annual Reports, 1860-1869, passim.

[107]Pewabic Mining Company, Annual Report For 1875, p. 9.

[108]Ibid., pp. 5-7.

[109]Annual Report of the Commissioner of Mineral Statistics of the State of Michigan for 1880 (Lansing, 1881) p. 134.

[110]The legal description of the Pewabic properties acquired by Quincy in 1891 included the following:

> Also, the right to mine by a perpendicular line all minerals lying North Westerly of a line running North, Fifty-eight (58) Degrees West from a point where the Pewabic Vein at the surface of the earth, crosses the dividing line between the lands of the Pewabic Mining Company and the lands of the Franklin Mining Company, being a part of the same rights and privileges that were conveyed to the Pewabic Mining Company, by Deed dated February 1, 1862, and recorded September 15, 1875,...

[111]A. J. Corey to Horatio Bigelow, 20 August 1873.

[112]QMC, Director's Minutes, Directors' Meetings of 4 March 1874 and 6 May 1874.

[113]Pewabic Mining Company, Annual Report For 1882, passim.

[114]QMC, Directors' Minutes, Directors' Meeting of 7 June 1882.

[115]Thomas F. Mason et als vs. the Pewabic Mining Company et als., Circuit Court of the United States For the Western District of Michigan, Northern Division, In Equity, "Opinion on Special Master's Second Report," filed 14 July 1893 by F. M. Moore, Clerk. Later, according to an undated "List of Stockholders, Pewabic Mining Company," Mason & Smith owned 8,150 shares of the total of 40,000.

[116]S. B. Harris to Mason, 15 April 1884.

[117]Nathan Daniels to S. G. Harris, 22 May 1884.

[118]Daniels to Harris, 2 December 1884.

[119]Ibid., 7 January 1885 and 12 March 1885.

[120]William Hart Smith to S. B. Harris, 10 January 1885.

[121]Ibid., 16 February 1886 and 19 May 1886.

[122]Ibid., 27 December 1886.

[123]Mason et als. vs. Pewabic Mining Company, et als.

[124]Nathan Daniels to S. B. Harris, 8 October 1890, 2 December 1890, 26 December 1890, and 27 January 1891.

[125]The major cases involved legal challenges to Peter White's Special Master's Report, made primarily by the Franklin Mining Company

[126]Nathan Daniels to S. B. Harris, 27 January 1891.

[127]Mason to Harris, 30 March 1891.

[128] *Ibid.*, 11 April 1891.

[129] *Ibid.*

[130] Harris to Mason, 10 October 1891 and 14 November 1891.

[131] QMC, *Stockholders' Minutes*, Stockholders' Meeting of 5 June 1889.

[132] QMC, *Directors' Minutes*, Directors' Meeting of 3 February 1891.

[133] Mason to the Quincy Stockholders, 26 February 1891 and QMC, *Directors' Minutes*, Directors' Meeting of 30 September 1891.

[134] Lawton, "Review," p. 28.

[135] *Boston Traveler*, 5 February 1891 and *Boston Transcript*, 13 February and 18 February 1891.

CHAPTER FOUR: EXPANSION AND MATURITY, 1888-1913

The changes brought by the air drill and related technologies in the early 1880's were significant in their own right, but did not come to full fruition until Quincy occupied the Pewabic lands and introduced a series of other innovations. A visitor who might have seen the Company's Michigan operations in 1875 and then returned a decade later would have noticed significant changes in plant and equipment, but would have still recognized the mine's broad outlines. However, if the same visitor was absent for another decade, returning to the mine in 1895, he would have been hard-pressed to find familiar technology, equipment, or buildings. In the interim the Company had built a radically different Stamp Mill, replaced the gravity tramroad with a steam railroad, and significantly altered most of the surface plant at the mine. The transformation of the Company's operations, at least in terms of technology and organization, was completed when Quincy erected its own smelter in 1898. The following fifteen years was an era of general expansion and prosperity. Many of the profound changes of the period 1888-1913 were associated with the growing size and complexity of the Michigan operations. Between 1885 and the peak years 1909-1911, copper output increased from roughly 3,000 tons to about 11,000 tons, while total Michigan employment went from 400 to slightly over 2,000. The changed character of the Company was not unrelated to the bitter strike which affected the entire copper district in 1913.

The Emergence of "The Greater Quincy," 1888-1905

Quincy's overall record before 1800 (Table 4.1) illustrates the dimensions of the growth brought through the application of new technology to a physically larger mine. The fundamental transformation took place between 1888 and 1893, years of unprecedented investment in new plant and equipment. Four major projects accounted for the bulk of the total investment of slightly less than $2 million in this six year period—the Pewabic land purchase ($800,000); the new stamp mill, including all related buildings and equipment ($449,649); the cost of shaft sinking and the new surface plant at Shaft Number Six on the Pewabic property ($323,166); and the Quincy and Torch Lake Railroad ($203,136).[1] The Company then invested an additional $160,000 in 1894-1895 to completely reconstruct the plant and equipment serving Shaft Number Two.[2] One major land purchase, discussed later in this chapter, absorbed $550,000 of the total spending of 1893-1896. Including the cost of real estate, the Company invested over $3 million in Michigan between 1888 and 1897. According to their own generous estimates of earlier investment, which includes more than $100,000 in inflated Civil War currency, Quincy's total investments from 1846 through 1887 amounted to $1.1 million.[3]

In this era of investments of $200,000 and above in a single complex, it is easy to ignore the dozens of minor building projects which took place in these years. Taken together, they significantly altered the mine's physical plant. The most expensive "minor"

TABLE 4.1: QUINCY MINING COMPANY, INDICATORS OF AGGREGATE PERFORMANCE, 1887-1900

	Total Employment	Output of Copper (Tons)	Average Sale Price (Cents Per Pound)	Gross Profits*	Permanent Investment and Real Estate	Net Profits	Dividends	Stock Quotations High	Stock Quotations Low
1887	447	2,802	11.7	$ 263,315	$ 75,587	$ 187,728	$200,000	$ 63	$ 45
1888	471	3,184	15.9	551,061	157,550	375,511	400,000	90	60
1889	485	3,203	11.9	342,151	159,550	182,601	200,000	85	46
1890	484	4,032	15.3	732,422	135,744	596,678	400,000	133	68
1891	652	5,271	12.8	1,526,829	1,111,859	414,970	450,000	115	85
1892	756	5,552	11.2	515,036	218,841	296,195	300,000	146	103
1893	885	7,198	10.4	586,145	224,931	361,214	350,000	144	80
1894	890	7,742	9.4	1,073,276	268,189	805,087	400,000	131	80
1895	968	8,152	10.1	1,095,077	232,088	862,989	600,000	170	98
1896	1,042	8,432	10.9	1,116,006	183,502	935,564	1,200,000	134	104
1897	1,066	8,462	11.1	1,062,245	57,026	1,005,219	700,000	129	104
1898	1,163	8,117	12.1	889,381	221,277	668,104	700,000	130	105
1899	1,355	7,151	17.1	1,333,148	404,481	928,667	1,110,000	190	125
1900	1,366	7,058	16.6	1,054,746	604,871	449,875	700,000	178	132

Source: QMC, Annual Reports, 1887-1900 and Lawton, Review, p. 30.

*Includes $800,000 in 1891 from a new stock issue and an additional $312,500 per year in 1894-1897.

improvements in the years 1888-1897 included the following—extensions to the Man Engine prior to 1892 ($10,384); driving the East and Lapp Adits in 1892-1895 ($23,067); construction of a supply office and oil house in 1893 ($9,539); upgrading the Quincy and Torch Lake Railroad in 1894-1896 ($23,525); and the construction of a new mine office building in 1895-1897 ($29,247).[4]

Quincy made these investments with little strain on the firm's resources. The real estate acquisitions were financed by issuing new stock and they paid for the remaining investments by plowing back part of the large operating profits of these years. Dividend payments were healthy, particularly after 1894 and the price of Quincy stock reflected the Company's profitability and future prospects. Even when copper prices bottomed out at 9.4 cents in 1894, the Company earned substantial profits because it had reduced its operating costs (excluding investment) to 4.8 cents per pound and was producing nearly three times the output of the mid-1880's.[5]

In order to assess the impact of the cluster of technological changes (stamp mill, railroad, and shaft-rockhouse) on output, costs, and profits, I will compare the Company's operations in 1887 and 1897. The first year was chosen because it was the last year of "normal" operations for the "old" Quincy. By 1897 the initial transformation was complete and they were about to embark on a second major investment program which extended from 1898 to 1903. The overall comparison of costs is summarized in Table 4.2 below. The Company tripled its profits by tripling output and maintaining the same profit margins as before, a less than remark-

TABLE 4.2: QUINCY OPERATING COSTS, 1887 and 1897 (Cents Per Pound of Ingot Copper)

	Output of Copper (Tons)	Total Employ-ment	Average Sale Price	Total Operating Costs	Mining Costs	Stamping Costs	Smelting Costs	Other Costs	Gross Mining Profits
1887	2,802	447	11.7¢	7.3¢	4.6¢	1.0¢	0.9¢	0.8¢	$263,315
(Share of Total)				(100%)	(63.%)	(14%)	(12%)	(11%)	
1887	8,462	1,066	11.1¢	6.8¢	4.8¢	0.7¢	0.8¢	0.5¢	749,745
(Share of Total)				(100%)	(71%)	(10%)	(12%)	(7%)	

SOURCE: QMC, Annual Reports, 1887, 1897: New York Journal, 1872-1893, p. 179 and and 1894-1905, p. 84; Cost Sheet For 1897, p. 8.

able achievement at first glance. These aggregate data, taken in conjunction with other information on the mine's operations, suggest far more substantial changes than are first apparent.

The significant savings in stamping costs reflected the impact of the new stamp mill, while the reductions in "other costs" came largely from a sharp drop in the expense of shipping mineral and ingot copper from Hancock to the final markets.[6] The overall performance in 1897 seems peculiar in some respects. "Mining Costs," which in this context include all operating costs prior to stamping, had increased in absolute terms and as a share of total costs in spite of the enormous investments in these operations. Since wages were a major part of operating costs and the total labor force grew significantly slower than output between the two years, one might have expected a substantial increase in the Company's profit margin. This did not take place because at the same time there was an overall upgrading of the workforce in terms of skills and pay. The share of miners in the total labor force increased from about 32 percent in 1887 to 37 percent in 1897, while wages also increased, so that the total payments to miners increased as fast as output. Since these payments amounted to almost one quarter of total operating costs in 1897, it is not surprising that profit margins did not change much.

The aggregate data on ingot copper output and costs do not reveal the fundamental change that had taken place at Quincy in the early 1890's. The Company was able to increase output threefold and maintain the same profit margin while mining substantially poorer rock. The declining copper content of the rock is reflected in the detailed data from the mine and stamp mill given in Table 4.3. In short, they were handling five to six times more rock in 1897 than a decade earlier in order to produce three times the output of ingot copper. It was because of the cluster of technological changes introduced in the interim that they were able to achieve these impressive results.

The changing quality of the rock taken from the mine was mainly an economic rather than a geological phenomenon, corresponding with the opening of the new stamp mill in 1890.[7] In the early part of the decade they were stoping out a backlog of poorer deposits left behind in the previous decade when they were practicing more selective mining. Once they had the material handling capacity in place, including hoists, skips, the railroad, and the stamp mill, it became profitable to mine deposits which were at best marginal under the old technological system. At the same time, the share of mass and barrel copper in total output increased substantially from 1890 on, for reasons which are not entirely clear.[8] There may have been a similar backlog of mass copper left unexploited during the 1880's or the mine may have become richer in terms of the pockets of mass and barrel copper they were finding. There is some evidence, however, that the increased share of mass copper was more apparent than real, simply reflecting a change in the way mass copper was handled at the rockhouses.[9]

The impact of the new technology becomes clearer when we measure costs in terms of the tonnage of rock handled rather than in

TABLE 4.3: AGGREGATE OPERATIONS OF THE QUINCY MINE AND STAMP MILL, 1887 AND 1897

	Output of Copper (Tons)	Rock Mined (Tons)	Rock Hoisted (Tons)	Rock Treated at Mill (Tons)	Mineral From Stamp Rock (Tons)	Yield, Mineral From Stamp Rock(%)	Total of Mineral and Mass Copper (Tons)	Yield of Ingot Copper From Mineral & Mass Copper Combined (%)	Share of Mass Copper in Total Ingot Output (%)
1887	2,802	124,289	96,370	94,240	3,046	3.23	3,372	83.2	11.6
1897	8,462	632,867	586,822	542,623	7,715	1.42	10,315	82.0	33.2
Percent Change	202	409	490	476	153	-56	206	-1	186

SOURCE: QMC, Annual Reports, 1887, 1897.

terms of ingot copper output. At the stamp mill, for example, operating costs per ton of ingot copper fell by 30 percent between 1887 and 1897, but the cost of stamping a ton of rock fell by 60 percent over the same period.[10] This divergence was even wider in the case of mining costs, summarized in Table 4.4 below. There were significant improvements in physical productivity which were only partially offset by higher wage rates. It is not clear why the tonnage per miner increased substantially, for the technology of underground mining did not change significantly between 1887 and 1897. This increase may reflect the time saved when Man-cars were used in place of the Man Engine to move the men to the workings, the use of more powerful explosives, increased air pressures to the drills, or simply improved organization of underground work.[11]

Quincy was encouraged or perhaps forced by the growth in its size and complexity to institute a more rigorous system of cost accounting starting in 1893.[12] The surviving Cost Sheets provide detailed information not available in other Company materials since 1877. The principle categories of expenditures in Michigan, excluding construction, are summarized in Table 4.5 below. They reflect an attempt to analyse costs along functional lines. "Mining Expense" included all underground costs incurred in finding and excavating the rock, but not the costs of moving it to the shafts for hoisting. The expense of operating the dryhouse, work performed on the surface but required for mining, the costs of producing compressed air (including steam), and even the costs of hoisting miners

TABLE 4.4: PHYSICAL PRODUCTIVITY AND COSTS OF QUINCY MINING OPERATIONS, 1887 AND 1897

	Number of Miners	Rock Mined (Tons)	Rock Mined Per Miner (Tons)	Monthly Wages, Contract Miners	Total Wages Paid To Miners	Wage Cost Per Ton Mined	Output of Copper (Tons)	Wage Cost Per Pound of Ingot Copper
1887	142	124,289	87.5	$44.80	$ 76,340	61¢	2,802	1.36¢
1897	393	632,867	161.0	52.52	247,684	39	8,462	1.46
Percent Change	176	409	84	17	225	-36	202	7

SOURCE: QMC, Annual Reports, 1887, 1897.

TABLE 4.5: QUINCY OPERATING EXPENSES IN MICHIGAN, 1897

Mining	$485,508
Hoisting	170,894
Rockhouses	52,847
Rock Transport	29,847
Stamp Mill	126,295
General Surface Exp.	15,843
Taxes	46,021
Dwellings	11,745
Other Expenses	18,890
TOTAL	957,890

SOURCE: QMC, Cost Sheet For 1887, p. 8

were charged to this account. The largest items were the payments of $349,750 to contract miners, which included $122,339 that the miners paid for supplies. "Hoisting Expense" included the wages of trammers, landers, and other underground laborers ($101,800), the cost of steam ($50,517), wire ropes and other supplies ($17,954), plus wages paid to engineers, firemen, carpenters, machinists, and other workers.[13] Unfortunately, these expenditures are not broken down by shaft.

These detailed accounts also permit a direct comparison between the operating costs of the older rockhouse technology at Number Four Shaft with the new combination shaft-rockhouses at Number Six (1892) and Number Two (1895), summarized in Table 4.6. The savings of roughly four cents per ton of rock handled needs to be placed in perspective. If it were applied to the total volume of rock handled, roughly 550,000 tons, it would represent an annual savings of $22,000, a significant figure, but nevertheless a small part of overall operating expenses. It is perhaps more significant that

TABLE 4.6: ROCKHOUSE OPERATING COSTS, 1897

	Rocks Handled (Tons)	Skips Received	Rock Per Skip (Tons)	Cost Per Ton of Rock Handled (¢)
Rockhouse No. 4	128,548	47,212	2.72	12.6
Shaft-Rockhouse No. 6	203,945	78,932	2.59	8.4
Shaft-Rockhouse No. 2	221,499	48,894	4.53	8.8

SOURCE: QMC, Cost Sheet For 1894, pp. 3,4.

the two newer rockhouses were able to handle larger volumes without experiencing higher costs. The Number Two Shaft was almost certainly using larger skips installed in 1894-1895 when the entire Number Two surface plant was rebuilt.[14] The Company then introduced larger skips at Number Six in 1898.[15] They reduced the number of times the hoist operated to raise a given tonnage of rock and probably reduced wear and tear on the hoists as a result. Aside from these advantages, the Company was probably forced to adopt larger skips because of the greater depths achieved in the 1890's.[16]

The increased depths of working in the early 1890's created additional problems for the Company shortly after they took control of the Pewabic properties. Because of the dip of the Pewabic Vein, the two northernmost shafts (Two and Six) were approaching the boundaries of Quincy's lands. To go deeper, the Company needed the rest of Section 23 (they already owned the SE ¼) located northwest of their property. This parcel was owned by the St. Mary's Canal Mineral Land Company and Quincy made a tentative inquiry about it in September 1891, but was discouraged by the high price the Canal Company wanted.[17] The Franklin Mining Company wanted the same property and their Agent, Graham Pope unsuccessfully tried to get Quincy's permission to drive the Franklin Number Five Shaft through the SE ¼ of Section 23.[18] Given the bad feelings between the two firms stemming from the Pewabic matter, it is surprizing that Franklin would bother to ask.

Nearly two years elapsed before Quincy took any decisive action on the Canal Company lands. In December 1893, the Quincy Directors agreed to pick up options held by Albert S. Bigelow, in the amount of $500,000 on the following—outright ownership of the W ½ and NE ¼ of Section 23; the mineral rights to the NW ¼ of Section 24 (Franklin owned the surface rights); and the surface rights on the SE ¼ of Section 23 (Quincy owned the mineral rights). They agreed to pay Bigelow a "bonus" of $50,000 for transferring his options on these properties.[19] Quincy was prepared to pay this much because the Number Two Shaft was reaching the edge of the Company's property and would soon have to be abandoned if nothing were done. This probably explains why they did not upgrade the surface plant at Number Two until 1894.[20]

The Directors made an initial payment for these lands of $150,000 taken from their 1893 earnings and called a special stockholders' meeting for March 15, 1894 to consider methods for financing the rest of the purchase prive.[21] They decided to issue an additional 50,000 shares of stock, par value of $25, providing the

Company with an additional $1.25 million to finance the land purchase and other comtemplated investments. They offered the new issue to existing stockholders in the form of scrip certificates which would be converted to fully-paid stock in April 1897 after four equal installments were paid. These payments were channeled into a special Trust Account, which was run separate from the Company's normal operating accounts. After the initial payment of $150,000 in 1893, the Trust Account disbursed additional installments of $100,000 in 1894 and $150,000 in 1895 and 1896.[22] When the Trust Account was closed in June 1897, the total of $1.25 million was accounted for as follows—Mineral Land purchase ($550,000); interest ($21,518); administrative expenses ($5,628); construction ($281,965); and the balance transferred to the Quincy Mining Company ($390,889).[23] This device enabled the Company to raise more than twice the funds needed for the land, permitting them to pursue other investments without dipping into operating profits or reducing dividends.

Quincy's drive to expand its landownings did not end with the Mineral Land purchase. Mason wanted the Franklin Mine as well and in April 1894, Quincy's Chaptain Thomas Whittle took an extended and presumably unauthorized tour of Franklin's underground workings, with Captain Thomas Dennis of the Franklin Mine serving as his guide and host. Whittle reported several rich pockets of stamp rock and mass copper, but estimated that the Franklin would be exhausted within five years at the current rate of exploitation.[24] Mason apparently decided to stand pat since he already had Franklin effectively hemmed in on three sides. Quincy renewed its interest in the Franklin lands in 1898, but did not finally acquire the property until a decade later.

They did, however, buy the lands of the Mesnard and Pontiac Mining Companies in 1896 at a bargain basement price. The two companies, which had been under common ownership since the early 1860's, were disastrous ventures from the start. The Mesnard Mine was the more successful of the two, but operated only sporatically in 1863-1877, producing a grand total of 42 tons of copper.[25] The abandoned properties consisted of two adjoining quarter sections on the Pewabic Vein (NE ¼ of Section 24 and the SE ¼ of Section 13) as well as 901 acres in Osceola Township, including lands on Torch Lake. In December 1895, Harris suggested that Quincy buy these lands, or at least the lakefront lands once they were free of pending (undisclosed) litigation which was going through the Supreme Court.[26]

The circumstances surrounding the Mesnard-Pontiac purchase are not entirely clear. Mason had bought a block of shares in both companies, perhaps to avoid another legal case like Pewabic. In January 1895 the Quincy Directors bought a total of 11,100 shares in the two companies from Mason for $8,934.[27] The lands were subsequently sold by the sheriff in July 1896, perhaps for taxes, and Quincy bought them through an intermediary, a lawyer named Chadbourne, for $34,050.[28] They discovered six months later that their title to the Pontiac property was in doubt because some of it was previously sold for taxes. This problem was apparently resolved without great expense, for Harris did not raise the issue again.[29] With the exception of the quarter section owned by Franklin, Quincy now owned most of the length of the Pewabic Vein where it outcropped on the surface.

By the late 1890's, Quincy's stockbrokers and management had good reasons to be optimistic about the Company's future. The real estate acquisitions earlier in the decade provided substantial reserves of copper-bearing rock. The new stamp mill was an efficient processing plant capable of future enlargement and the Quincy and Torch Lake Railroad provided a secure, economical transportation network linking mine and mill. However, the Company was not in full control of its own affairs as long as it depended on outside firms to smelt its mineral. Because of generally unsatisfactory relations with these firms, Quincy had seriously considered building its own smelter as early as 1884, but did not do so until 1898.[30]

They had sent all of their mineral to the Detroit works of the Waterbury and Detroit Copper Company from 1856 until 1872, when they began to split their shipments between the two plants (Detroit and Hancock) of the Detroit and Lake Superior Smelting Company.[31] In the 1870's, Quincy paid $17 a ton for mineral smelted in Hancock and $15 for mineral sent to Detroit.[32] Mason was annoyed when the Detroit and Lake Superior Company increased the Detroit smelting charges to $15.50 in 1884 and asked Harris to investigate other options.[33] Price was not the only source of irritation, for Quincy claimed to get better yields of copper from the Detroit plant than from the Hancock works of the same company.[34] When the Detroit works closed in 1887, the Company had only one practical option left if it were to continue using an outside firm.[35] However, by this time several of the large Michigan mines had reassessed their smelting arrangements and had found it economically desirable and technically feasible to construct their own smelters and thus fully integrate their operations. Calumet and Hecla opened its own plant at Hubbell in June 1887 and the Tamarack and Osceola Mining Companies jointly built a rolling mill and smelter at Dollar Bay in 1888-1889.[36] The Hancock smelter and the new Dollar Bay works merged in August 1890 to form the Lake Superior Smelting Company, which temporarily reduced its smelting charges from $13 to $11 per ton of mineral, probably to discourage firms like Quincy from following the example of Calumet and Hecla.[37]

Once Quincy occupied the Pewabic lands and began expanding output, the smelting question was put back on the front burner. By July 1892, the Company decided to build its own smelter and in September contracted with James R. Cooper and his son, James B. Cooper to build and operate the plant.[38] For several months the Coopers considered various sites for the new smelter, while Mason continued to negotiate with the thoroughly-frightened Lake Superior Smelting Company. This firm finally signed a five-year contract commencing May 1, 1893 to smelt all of Quincy's mineral at $11 a ton. The Coopers then agreed to allow Quincy to cancel their contract and a resolution of the smelter issue was temporarily postponed once again.[39]

This five-year contract gave Quincy time to complete other more pressing and expensive investments to keep the mine operating.

In November 1896 the Quincy Directors authorized Mason to negotiate a contract with James B. Cooper to build a smelter for $10,000 or less, operate it for five years commencing May 1898, and smelt all of Quincy's mineral for $9 a ton.[40] They signed an agreement with Cooper on September 25, 1897, providing for smelting charges of only $7 a ton.[41] The Company examined a bewildering variety of options in 1897 and early 1898, including new contractual relations with outside firms, the purchase of an existing smelter, and several locations for a new plant. They finally decided to build on the Pewabic stamp sands on Portage Lake in Ripley, but because of numerous delays, they had to send their mineral to the Calumet and Hecla smelter for much of 1898.[42] The Quincy Smelting Works began treating mineral in December 1898, finally completing the integration of the Company's major operations.

The decision to build a smelter was largely but not entirely made on economic grounds. The funds invested in the Smelting Works in 1898-1900 ($146,617 excluding the value of the real estate) paid off handsomely.[43] Between 1897 and 1901 smelting costs per ton of ingot copper fell from $15.30 to $10.06, suggesting an annual savings of about $50,000 by the later year.[44] In addition to the economic considerations, the Company was also motivated by a desire to have tighter control over its own product. William Rogers Todd argued that by having their own smelter, Quincy could establish its own (superior) brand and more readily maintain a separate identity in the minds of consumers.[45] Quincy's independence and prestige were also significant considerations in the smelter decision, particularly for the major Company officials. In early 1898 Todd warned Harris: "Don't get impatient as we are bound to finally have 'the Greater Quincy' and it promises to materialize before 1900."[46]

The smelter was only one part of the Company's massive investments of 1898-1902 amounting to $1.7 million. Five projects accounted for three-quarters of the total: the Quincy Smelting Works ($146,617); the Number Two Stamp Mill ($331,005) begun in 1899; a modern coal-handling facility on Torch Lake built in 1901-1902 ($180,595); sinking and equiping the Number Seven Shaft at the southern end of the Pewabic Vein in 1898-1900 ($378,769); and similar work at the more modest Number Eight Shaft on the Mesnard property in 1899-1902 ($180,595).[47] In addition to these costly and spectacular projects, the Company was upgrading and making additions to the rest of its plant and equipment through dozens of smaller projects. Construction on the Quincy and Torch Lake Railroad cost $111,480 in 1898-1902. They spent nearly $21,000 on utility trench construction in 1899-1900, a similar amount on a new blacksmith shop, and smaller sums on about two dozen other projects.[48]

The investments of 1898-1902 must be assessed in terms of their impact on the Company's costs and profits. Table 4.7 compares the overall cost structure in 1897 and 1905. The Company was able to widen its profit margin on each pound of copper in spite of a sharp rise in mining costs in both absolute and relative terms. This cost increase took place because there was a continued deterioration in the quality of stamp rock, combined with a decline

TABLE 4.7: QUINCY OPERATING COSTS, 1897 AND 1905 (Cents Per Pound of Ingot Copper)

	Output of Copper (Tons)	Total Work-force	Average Sale Price (Cents Per Pound)	Total Operating Costs	Mining Costs	Stamping Costs	Smelting Costs	Other Costs	Gross Profits
1897	8,462	1,066	11.1¢	6.8¢	4.8¢	0.7¢	0.8¢	0.5¢	$749,745
Percent Share				(100)	(63)	(14)	(12)	(11)	
1905	9,414	1,714	15.8¢	10.1¢	8.2¢	1.2¢	0.4¢	0.3¢	1,075,197
Percent Share				(100)	(81)	(12)	(4)	(3)	

SOURCE: QMC, *New York Journal*, 1894-1905, pp. 84, 295; *Cost Sheets*, 1894-1905; and *Annual Reports*, 1897-1905.

in the amount of mass and barrel copper during these years (see Table 4.8 below). In crude terms, the Company had to handle twice the volume of rock in 1905 in order to achieve an 11 percent increase in ingot copper output. The poorer quality rock combined with a declining share of mass copper in the total produced a disastrous fall in the yields achieved at the smelter.

The Company was able to hoist a much larger tonnage of rock from greater depths more cheaply in 1905 than in 1897, a significant accomplishment. Comparative data on the rockhouses (Table 4.9) show the importance of the two newer shafts, especially Number Seven, in handling the larger tonnage. The use of larger skips and improved rock screening methods at the three main production shafts reduced costs while increasing the tonnage handled.[49] The overall cost reduction of 3 cents a ton implies an annual savings of over $30,000 on the 1905 rock tonnage.

More significantly, the Company was able to achieve significant reductions in its total hoisting expenses (which included tramming) after the turn of the century.[50] Beginning in 1901 Quincy rapidly adopted electric locomotives for tramming and simultaneously installed large underground storage bins which dumped directly into the skips in the shafts.[51] Total hoisting expenses, which had peaked at 39 cents a ton in 1900, fell to 30 cents in 1905. Half of the savings can be directly attributed to electric haulage while the rest resulted from other improvements including the use of underground rock bins.[52] The total savings of 9 cents a ton meant a cost reduction of over $100,000 on the 1905 rock tonnage.

TABLE 4.8: AGGREGATE OPERATIONS OF THE QUINCY MINE AND STAMP MILL, 1897 AND 1904

	Output of Copper (Tons)	Rock Mined (Tons)	Rock Hoisted (Tons)	Rock Treated at Mill (Tons)	Mineral Produced From Stamp Rock (Tons)	Percent Yield, Mineral From Rock	Total of Mineral and Mass Copper (Tons)	Percent Yield, Ingot Copper From Mineral and Mass Copper	Share of Mass Copper in Total Ingot Output
1897	8,462	632,867	568,822	542,623	7,715	1.42%	10,315	82.0%	33.2%
1905	9,414	1,222,257	1,168,519	1,135,162	13,253	1.19%	14,712	64.1%	15.4%
Percent Change	11	93	105	109	72	-16	43	-22	-54

SOURCE, QMC, Annual Reports, 1897, 1905.

TABLE 4.9: ROCKHOUSE OPERATING COSTS, 1897 AND 1905

Shaft	1897 Rock Handled (Tons)	1897 Rock Per Skip (Tons)	1897 Cost Per Ton of Rock Handled	1905 Rock Handled (Tons)	1905 Rock Per Skip (Tons)	1905 Cost Per Ton of Rock Handled
No. 4	128,548	2.72	12.6¢	60,329	2.39	10.8¢
No. 6	203,945	2.59	4.4¢	364,509	6.77	5.4¢
No. 2	221,499	4.53	8.8¢	306,190	6.71	6.2¢
No. 7	-	-	-	305,146	6.41	6.8¢
No. 8	-	-	-	116,260	2.48	7.6¢
Total or Average	568,822	3.25	9.5¢	1,168,519	5.34	6.5¢

SOURCE: QMC, Cost Sheet, 1897, pp. 3,4 and Cost Sheet, 1905, pp. 3-5.

The enormous changes the Company experienced between 1887 and 1905 need to be reemphasized. In the former year, Quincy hoisted less than 100,000 tons of rock from two shafts (maximum depth of about 2,900 feet), while in 1905, they hoisted twelve times the tonnage from five shafts, the deepest reaching 5,500 feet below the surface. A gravity tramroad had been replaced by a modern steam railroad. The badly overworked and outmoded stamp mill on Portage Lake had been replaced by two of the most modern plants in the district, handling twelve times the tonnage handled at the old mill in 1887. Finally, the Company had cut its smelting costs in half by erecting its own plant. Along with these enormous technological changes, the Company's size had also increased greatly. The output of copper nearly quadrupled as did the labor force, which increased from about 450 in 1887 to over 1,700 by 1905. With annual expenditures of over $2 million, Quincy had become a significantly larger and more complex operation than it was in the 1880's. There were also significant changes in managerial and business practices, the nature of the labor force, and the relationship between management and labor, which will now receive more detailed attention.

The Quincy Management, 1888-1905

The New York management team of Thomas F. Mason and William Rogers Todd, which had effectively controlled the Company since Mason's reelection to the Presidency in 1875, continued in power through the 1890's. In fact, Mason's position within the Company was never stronger, largely because he and W. Hart Smith had retained most of the 10,000 shares of stock they acquired in the Pewabic land deal of 1891. He also had the confidence of enough of the other large stockholders to retain control. For the Special Stockholders' Meeting held on March 15, 1894, some 40,678 shares of the total of 50,000 were represented by proxy. Mason held proxies for over 13,000 shares in addition to the 10,092 owned by Mason and Smith, while his Boston ally, Nathan Daniels, held another 17,518 proxy votes. Although there were more than six hundred stockholders altogether, the ten largest held nearly half the shares.[53]

Mason had become skilled at controlling and maintaining the confidence of the major stockholders. The Daniels family, which held a block of 4,100 shares, was given considerable power in Company affairs, with Nathan Daniels serving as a Director in 1891-1898 in addition to running the Boston Transfer Office. Mason also increased the number of Directors from five to seven in 1897 in order to bring several large stockholders directly into the Company's power structure. In doing so, he gave the Board stability which extended into the 1920's.[54] In 1891 he made his son Thomas Henry Mason a Director and the younger Mason also served as Quincy's first Vice President from June 1892 until his father's death in June 1899.[55] The elder Mason was able to dominate in part because ownership was concentrated in a few hands, a situation which continued throughout this period.[56] However, he did not control the Company simply because he was a skillful manipulator. Under his direction, Quincy had become enormously successful and the combination of knowledge, experience, and past performance gave Mason great power and prestige.

Thomas Fales Mason died on June 2, 1899, having served as Quincy's President since January 1858, with a brief interruption in 1872-1875. At the Annual Meeting held less than a week later, William Rogers Todd delivered a eulogy which accurately assessed Mason's role in Quincy's history:

> The success of the company was largely due to his untiring efforts, his clear foresight, good judgement and close attention to details. He was the father of the company. He lived to see his fondest hopes realized, his ambition achieved, and the Quincy mine must ever stand as a monument that needs no scroll for him who has passed away. No one acquainted with the history of the rise and development of the copper mines of Lake Superior, can gaze upon the property of the company without being reminded of the man with whom its success must ever be associated, although we know he had able assistants, and he was ever ready to bestow upon them full credit and praise for all they did. I do not think there is one among them but is ready to say that Mr. Mason was the ruling spirit, and in all their duties they looked to him for advice and approval.[57]

T. Henry Mason was elected President immediately after his father's death and held the post until November 1902, when he died. The Directors then elected William Rogers Todd as his successor.[58] Todd served as President until his death in June 1924, ending a remarkable career of sixty-four years with the Company. His son, W. Parsons Todd then served as Quincy's President from 1924 until 1976. Since the elder Mason had groomed the elder Todd to manage the Company, Quincy was in effect under the same management from 1858 to 1976.

The transfer of power from the elder Mason to W. R. Todd had begun well before Mason's death and Todd in essence ran the Company during the younger Mason's brief tenure as President. The transitional period was marked by growing conflict between the New York officials, primarily Todd, and the Michigan officers, especially S. B. Harris and his son John L. Harris. This conflict will be considered in detail later in this chapter, when I examine the Michigan management in detail. The source and tone of the Company's correspondence during the younger Mason's three and a half year tenure suggest that Todd was making the most important decisions with the implicit support of several key Directors, particularly Charles J. Devereaux of Boston.

Even though there was conflict within the New York office and between it and the mine officials, the New York officers continued to run the Company effectively. The Eastern office was responsible for considerable cost savings for the firm. Mason, for example, had begun the practice of having the New York officers take responsibility for selling Quincy's copper rather than rely on brokers as most other mines did. This practice had two major advantages— they saved the commission or brokerage fees (usually 1½%) that they would have to pay to outsiders and they could receive higher prices as well, particularly if the Company's financial position enabled them to wait for the most favorable prices. As Quincy's production climbed in the 1890's these economies became significant. In 1901-1906, the savings in brokerage fees alone amounted to nearly $238,000 or roughly $40,000 a year, while they received higher than average prices for their copper. When compared to the prices realized by the Osceola and Tamarack mines, two large producers, Quincy enjoyed extra revenues of $735,000 in 1901-1906, or about $120,000 a year.[59] To be sure, some of this price differential probably reflected the real or imagined superiority of Quincy copper over that of other mines.

The New York management also successfully confronted a serious threat to the Company's independence. In 1899 a group of financiers associated with Standard Oil established the Amalgamated Copper Company of New Jersey for the purpose of buying all the major American copper mines. The effort ultimately failed because they were unable to get control of either Quincy or Calumet and Hecla.[60] Amalgamated began buying Quincy stock in February, when Harris observed: "The Standard Oil Octopus should not be allowed to grab the Quincy at $200. The stock will be worth that, anyhow, on its own merits in a year from now, even with copper much lower than at present."[61] They were also acquiring mineral properties in Michigan and Harris bemoaned Quincy's failure to have bought all the nearby real estate which might have some future value:

> It seems that the Standard Oil people are getting a rake-off on the Lands in this District. It looks to me that there will be no 'Franklin' or 'Anthony' or anything else left for us, soon. We are 'not in it' for they act as if they mean eventually to gobble us all up. I am afraid we have waited too long in this matter.[62]

This takeover attempt caused considerable alarm in the New York Office, but did not come close to success because Quincy stock was too concentrated in relatively few hands, At the same time the Company was expanding rapidly in the 1890's, it began to gain international recognition as a major copper producer, in part because the New York office decided to spend the funds needed to exhibit their products. As the Chicago World's Fair (Columbian Exposition) held in 1893, Quincy was awarded a medal for its exhibit, "Mass Copper, Ores, Sands, Sluices and Palings." The text of the award noted that the exhibit included a single copper mass of 3,800 pounds, copper-silver halfbreeds, and a variety of samples of dressed rock, sluices, and mill palings.[63] The Company later won a gold medal at the St. Louis World's Fair in 1904 for a similar exhibit.[64]

Supervising the Company's mining operations through its Michigan management team remained New York's chief responsibility. Samuel B. Harris continued to serve as the Agent from 1884 until 1902, but with frequent conflicts with the New York officers. The Directors seemed satisfied with his performance and increased his salary regularly, to $6,000 in 1888, then to $8,000 in 1893 and finally to $10,000 in 1897.[65] They also gave him a piece of land in Hancock in 1892 as a reward for the additional work he had taken on to develop the Pewabic property and in general recognition of his hard work on the Company's behalf.[66] He was also given a rent-free house at the mine in addition to his salary, which was second only to the President's. In 1893, for example, Mason earned $10,000 and Todd $5,000, while Harris was paid $8,000 per year.[67] Harris resigned the Agency in May 1902 at the age of sixty-seven and then held several positions with two banks and an electrical utility in Hancock and Houghton before his death in October 1927 at the age of ninety-two.[68]

The events which finally led to Harris' resignation throw a good deal of light on the internal operations of the Company during this period. Although Harris had generally retained the elder Mason's confidence, the two had clashed on the issue of the Agent's autonomy at the mine. A protracted arguement developed over appointing a new Mine Clerk after the incumbent Daniel Kloeckner sucessfully committed suicide in early March 1892 by shooting himself in the head during his lunch hour. Kloeckner had personal financial problems, but had not misused any Company funds.[69] Harris immediately demanded that he not only be consulted in the choice of a new Clerk, but that he make the appointment and that it be understood that the Clerk be responsible to him and not to New York. Harris had suffered through a poor relationship with Kloeckner which he did not want to repeat. He was vehement in asking Todd to intervene with Mason on his behalf:

> We have all seen the evil arising out of the attempted belief in a quasi-independent position of officers of this mine and I hope to Heaven it will never be repeated while I am here. If a man in my position is not capable of commanding the ship in these waters—under instructions from Headquarters—he ought to be removed, if he has not pluck enough and self-respect enough to resign. I cannot, I will not run the risk of repeating the miserable experience I have endured here in the past and if Mr. Northrup—who in many respects would be to me a worse pill if possible than Kloeckner—if Northurp, I say, or any of his ilk obtain the appointment—I shall get out of here.[70]

Mason appointed N. B. Walker to the position in early June, but within six weeks Harris complained that Walker was totally incompetent and should be fired immediately.[71] Mason removed Walker of August 6th and instructed Harris to put Angus MacDonald (Supply

Clerk) in charge of the mine office.[72] A week later Harris strongly recommended Edward Johnson, the Chief Assistant Bookkeeper at Calumet and Hecla and Mason appointed him in early September.[73] Johnson was apparently satisfactory to everyone and served as Mine Clerk until October 1899. Harris then appointed Armitage Benedict to the post, with little consultation with New York.[74] Benedict worked out so badly that Harris transferred him to the Supply Office on June 30, 1900 and once again had Angus MacDonald take over the mine office.[75] Harris thought that Benedict "should make a good man for that position (Supply Clerk) as he has had considerable experience in such work."[76] Benedict lasted exactly two months in his new position before Harris fired him.[77] The Agent had to admit showing bad judgement in the entire matter:

> When Benedict came here I expressed the opinion that he was either a most excellent acquisition or an unmitigated fraud—he evidently is the latter with a big F—(I) guess you sized him up quicker than I did. He is one of the slickest liars I ever met—and there is much of the mysterious in his make up and history. Maybe we shall have better luck next time.[78]

The disagreements over who would appoint the Mine Clerk were not petty because broader questions of control were at stake. Understandably, the New York officers wanted to retain control over the post simply because of the financial responsibilities involved and they preferred an autonomous Clerk to prevent collusion between him and the Agent. Besides, an independent Clerk could serve as New York's "eyes and ears" in Michigan, as a double check on the Agent.

The abortive Benedict appointment also brought to the surface some fundamental doubts that Todd and some of the Directors had developed by early 1900 concerning Harris' management of the Michigan operations.

In August 1900, Director Charles Devereaux spelled out some of the complaints against Harris in a lengthy letter to Todd. The Agent had been absent from the mine without permission, leaving it in the hands of his son John, who Devereaux described as "of no earthly use."[79] The elder Harris had bought unneeded coal and worse, had paid cash for it even though this was not required. The most serious charge was that several key Michigan officials had been "moonlighting" or engaged in outright fraud and had earned a great deal of money as a result. Devereaux implied that there had been a plot involving key figures in the Michigan management team—the Agent, his son, Benedict (Clerk), MacDonald (Supply Clerk), Moore (Master Mechanic) and Morrison (Boss Carpenter). In discussing S. B. Harris' role in all of these matters, Devereaux concluded that there "is certainly a strong indication that his mind is either growing weak or else he has too much other business to attend to, in either case the Quincy Company are the sufferers."[80]

Harris' relationship with the tandem of Todd and Devereaux continued to deteriorate, leading ultimately to his resignation. In February 1901, Devereaux again questioned the honesty and competence of the Michigan management and urged Todd to appoint a new Mine Clerk and a new Supply Clerk, suggesting that his son, W. Parsons Todd take the latter position. He also asked rhetorically, "Why was not the former Mine Clerk (Benedict) arrested and made to pay the penalty of his shortage?"[81] Devereaux agreed to support Todd's plan to replace Harris as the Michigan Director with Thomas Dunstan, Quincy's lawyer in Hancock. He added, "I believe that the reforms we are after we will never find (un)till the head is changed. I do not know if the time is now or not."[82] At the June 1901 Annual Meeting, Harris lost his position as Director and Todd tried (lamely) to explain why he had not given Harris any advance warning of the change. Todd also reassured Harris that the New York office was pleased with everything at the mine, except for "that miserable and irrepressible gossip of your section."[83]

Todd's displeasure with Harris' performance went beyond the individual appointments he had made and other specific transgressions. During the final years of Harris' tenure, certainly by 1900, there was a broader criticism, implied as much as explicitely stated, that under Harris the Michigan management had become fat, lazy, smug, and overpaid as a result of cronyism. In July 1902, a month after the elder Harris had resigned, Todd proposed a major shakeup of the middle level management at the mine. He argued that James Moore, Master Mechanic since 1889, was grossly overpaid, as was the Boss Carpenter R. M. Morrison, who Todd thought should be firec. Finally, he suggested that they replace Thomas Whittle, the Head Mining Captain since 1889:

> We would call your attention to Captain Whittle's turnout. On passing his residence last week, (I) saw his horses, carriage and coachman (a man working for the Company) standing in front. Such things we think, show bad taste, interferes with business and exercises a demoralizing effect on others, and should be discontinued. Knowingly permitting it, I think reflects unfavorably on the Superintendent and myself.[84]

Todd also attacked the entire system of compensating mine officials, which had traditionally included free housing, medical service, heat and light, horses and carriages, and a variety of other fringe benefits. His desire to eliminate these perquisites may simply reflect an urge to rationalize the managerial pay structure, but it was almost certainly encouraged by his belief that the mine officials were abusing their positions. By itself, changing the rules governing compensation was a way for New York to reestablish its authority over the mine. In January 1900 Devereaux proposed and the Directors approved a plan to phase out all perquisites by July 1st and simultaneously raise salaries of the officials affected. He argued that while these customary fringe benefits were required to attract good managers during the early years of the mine, when salaries were low and the copper district was a primitive frontier, they were no longer needed because salaries were more than adequate. In addition, the Agent would no longer be required to house and entertain New York officials when they came to Michigan.[85]

Harris sent the Directors a list of sixteen officials who enjoyed significant perquisites and proposed a new salary structure to compensate them for the loss of these benefits. The Directors accepted the new salary schedule, which was to go into effect retroactively to July 1st.[86] The old customs did not die easily, for two years later several mine officials wanted housing to be included in their contracts with the Company. Todd not only rejected this out of hand, but suggested two other changes in customary practice. He suggested that all Underbosses (managers under the rank of Captain) be employed by the month, rather than by the year, so that they could be dismissed without the customary two months' notice.[87] Finally, he argued that Quincy should stop selling coal to its employees at subsidized prices:

> The time for 'paternal' care of our men I think has passed and therefore (I) would advise you in delivering coal to those who may want to take it from the company, to fix the same price as (we are) charged for (it) at the coal yards at Houghton or Hancock, granting only a concession of free delivery.[88]

The assault on traditional practices at the mine was in part an attack on S. B. Harris and the management team assembled during his term as Agent. It is not clear what precipitated the decision, but on May 10, 1902 the Quincy Directors asked Harris to resign, effective immediately. He offered to step down at the end of the year, but the Board chose to interpret his offer as an immediate resignation, which they accepted on June 4th. They agreed to pay his salary for the rest of the year "out of consideration of his long service in the employment of the Company" and set into motion the machinery to find a new Superintendent.[89] This victory for Todd and his supporters was only one battle in the struggle for power which continued until late 1905.

After months of bitter controversy in the second half of 1902, Samuel Harris' son, John L. was appointed Superintendent in December. Unlike his father, the younger Harris had considerable formal engineering education. He graduated from the Michigan College of Mines in Houghton and then did post-graduate work at M.I.T. beginning in

1890. He was working as Quincy's Chief Mining Engineer by 1897[90] and was then appointed Assistant Superintendent in June 1899 at a salary of $3,600 a year.[91] When the elder Harris resigned in May 1902, Todd tried to reassure his son that he would keep his job as long as he performed well.[92] In spite of these polite assurances, the two men were totally incompatible and Todd was simply trying to buy time.

Although Todd had reluctantly appointed the younger Harris Acting Superintendent after his father's resignation, he soon lost his remaining trust in Harris' ability and character. In early July Harris had agreed to dismiss the Boss Carpenter Morrison, but wanted to wait until the end of the month to notify him.[93] In early August Morrison wrote a letter to Todd defaming J. L. Harris and at about the same time an anonymous letter from "a stockholder" in Laurium came to Todd, who then sent copies of both bombshells to Harris. The accused then wrote a nine-page typewritten rebuttal to the charges. Among other things, Morrison claimed credit for dozens of improvements at the mine which had been attributed to the younger Harris. He also claimed that he had often taken the blame for Harris' mistakes and general incompetence. Harris rightfully suspected that Morrison was also the author of the anonymous letter, which was even more damaging. Its author claimed that Harris drank excessively, often had to send a mine employee to Hancock "to procure a package of sweet-scented chewing gum to mask the fumes of whiskey" and spent many weekends in Chicago on drunken debauches. Finally, the letter claimed that one of Harris' Chicago visits was prolonged so that he could "receive treatment for a disease that evokes no sympathy." In defending himself, Harris claimed he had pneumonia during one visit to Chicago in February 1900 and produced a Doctor's note to prove it.[94]

Although most of the charges were probably untrue, they must have been disconcerting to Todd, who already mistrusted the younger Harris. In the course of defending himself Harris was forced to reveal that he had left the mine without permission at the same time his father was also absent.[95] We can see from some of Harris' later correspondence that Todd's misgivings were well-founded. In late September, Devereaux suggested that they close up the Superintendent's mansion and force Harris to board at the Douglass House in Houghton, perhaps so that he would not develop any illusions of becoming the permanent Superintendent.[96]

Todd contineud to bide his time until he became President after T. Henry Mason's death in November. At that point the younger Harris tried a desperate, but successful gamble. In mid-November he threatened to resign, effective December 1st, if he was not appointed Superintendent. Harris' contempt for the Eastern management, particularly Todd is revealed in a letter he wrote to a close friend at the time of this gamble:

> Judging from the general manipulation of local affairs at both the Adventure and Quincy Mines during the past six months or so, I do not think it at all probable that the Eastern Management—'todd' (spelled with a small 't') will see matters in this light. I decided to have the satisfaction of resigning before the new man received the appointment.[97]

The strategy worked and J. L. Harris was appointed Superintendent on December 1st, at a salary of $7,500.[98] He was still gloating over his victory a few months later:

> I am now "Cock of the walk" at least until his Royal Nibbs (t-o-d-d-i-e) shows his hand again (but I presume he will be a good little boy now) when I will adopt the same tactics as I won out on last fall.[99]

Using the parlance of a poker game, Harris conceded that he had bluffed, holding only a "busted straight," but the next time would be in a stronger position, holding a "pat hand" or a "Royal Flush."[100] The rest of Harris' letter deserved to be quoted because it reveals his (twisted?) perceptions of Todd and the New York office generally:

> I honestly believe that this recent Quincy "mix-up" was the most foolish to say nothing about underhanded manipulation of matters that has ever taken place in the whole copper country and all brought about by the little man, the little foxy man, the little smooth two-faced man from Morristown. There was great rejoicing among the different Departments at the Mine and Mills when "Johnnie came marching home" from New York which by the way was on Thanksgiving day. The band serenaded me in the evening and everybodys (sic) cup was apparently filled to overflowing. It must have made "toddie" feel good? (sic) to read some of the various articles in the different newspapers about that time.
>
> I never know or heard of a man who was credited with ordinary common sense make such a fool of himself as this person whose surname I invariably spell with small letters. The mining men of this section are not only after his scalp but the Banker, Butcher, Baker, Barber and a few others would like to get their fingers into his "curly locks."
>
> Mr. Thomas H. Mason (son of the old man) died last fall and mr. t. who has actually been the President since the death of the senior Mason—was appointed President of the Company. One of the reasons for this appointment was because there was really no other person, i.e., Director—who knew anything about the affairs of the Company or (was) desirous or competent for the position. Not only this

> but foxy t. is so cunning, sly and underhanded and such a good schemer, in his way, that he has the two active Directors (Devereaux and Meserve) stuffed "good" and they actually think that there is no one on earth so competent to manage the affairs (Eastern end) of the Company as t--ie. They may undergo an operation for caterack some of these days, however, and see for themselves, especially in the manipulation of affairs and satisfactory? results obtained up to date and the probable Irish dividends of the much talked Adventure Consolidated Copper Company of Greenland, Ontonagon County Michigan.[101]

Given the mistrust on both sides, it is surprizing that Harris managed to keep the Superintendent's position for three years. Perhaps Todd was simply waiting for the right man to become available before replacing Harris. This finally happened in July 1905, when the Company hired Charles Latham Lawton as Superintendent, effective December 1st.[102] Harris remained in the area and managed the Hancock Consolidated Mining Company from June 1906 until his resignation in June 1917.[103] Lawton became the last Superintendent to manage significant underground mining efforts on the Pewabic Vein, holding the post until his death in July 1946, by which time the mine had closed. His tenure was not without conflict with the New York office, but he nevertheless survived for forty years. His appointment marked the end of the painful transition in Quincy's management that had begun with the death of Thomas F. Mason in 1899.

Charles Lawton, although born in Auburn, New York in 1863, had deep roots in the Michigan copper industry. His father, Charles De Witt Lawton was a Regent of the University of Michigan and had previously served as the Commissioner of Mineral Statistics for the State of Michigan, while his brother, Swaby L. Lawton was a partner in the law firm of Hanchette & Lawton in Hancock. The new Superintendent also had impressive educational credentials and mining experience. He graduated from the "mechanical department" of the Michigan Agricultural College in 1888 and then earned a degree in Mining Engineering at the Michigan College of Mines. Lawton's mining experience included work in iron, coal, silver, and copper mines in seven states. When called to Quincy, he was superintending the Dalton & Lark mine of the Bingham Consolidated Company in Salt Lake City.[104] The evolution of the mine management under Lawton will be considered later in this chapter. We now need to examine the remaining ninety-nine percent of those who worked for the Company during these years.

The Labor Force and Labor Relations, 1888-1905

As the Company expanded its operations beginning in the late 1880's, the workforce changed significantly, not only in terms of size, but in its ethnic composition as well. Simultaneous changes in the nature of management produced a significant change in the nature of labor-management relations during this period. The most apparent symptom of this change was the growth of labor unrest, including a relatively large number of strikes. All of these developments were intertwined and will be considered in detail.

In 1885 the Company had a total of 403 employees in Michigan, including all managerial personnel. Two decades later there were 1,714 working at the mine and stamp mills (Table 4.91), plus another 120 at the Quincy Smelting Works.[105] Nor surprizingly, there was

TABLE 4.91: QUINCY MINING COMPANY LABOR FORCE, 1905

Number	Position	Monthly Wages
1	Superintendent	$833
1	*Assistant Superintendent	N.A.
1	Clerk	275
2	Assistant Clerk	65-125
1	Supply Clerk	166
4	*Assistant Supply Clerk	44-65
3	Physician	208-333
1	*Pharmacist	83
2	*Civil Engineer	100,125
3	Assayer	47-55
1	*Stenographer	52
	Underground Mining	
1	Head Mining Captain	393
2	1st Assistant Captain	155
14	*Undercaptain	80-125
2	*Boss Timberman	67-72
45	Timberman	55
571	Rand Drill Contractor	65
23	Stoper, Company Account	N.A.
15	Drill Boy	24-30
287	Lander & Trammer	
	*Lander	55
	Trammer	60
209	Underground Laborer	50-52
	Surface	
1	Surface Labor Boss	140
61	Surface Laborer	43
6	*Teamster	50-58
1	Rock House Boss	80
9	*Rockhouse Underboss	53
65	Rockhouse Laborer	50
3	Mason	67-72
1	Boss Carpenter	150
1	Carpenter Foreman	88
22	Capenter	57-73
1	Boss Blacksmith	130
5	*Drill Sharpener	75
4	Blacksmith	77
1	Master Mechanic	225
1	Boss Machinist	110

TABLE 4.91: QUINCY MINING COMPANY LABOR FORCE, 1905 (continued)

Number	Position	Montlhy Wages
	Surface (continued)	
13	Machinist	$63-75
22	Machinist's Helper	32-55
13	Hoist Engineer	63-69
7	Rockhouse Engineer	49
6	Compessor and Pumping Engineer	52-57
6	*Wiper	55
39	Fireman	53
3	Watchman	52-61
	*Quincy & Torch Lake Railroad	
1	Superintendent	100
1	Dispatcher	98
1	Yard Master	78
4	Engineer	77-84
4	Fireman	57-60
8	Brakeman	57
3	Conductor	67
2	Wiper	48-52
3	Helper	52-57
4	Car Filler	49
26	Section Man	44
1	Machinist	78
1	Car Inspector	63
	Stamp Mills	
1	Superintendent	250
1	Clerk	77
1	Wash Boss	112
1	Boss Machinist	100
1	Boss Carpenter	102
1	Boss Blacksmith	86
133	Stamp Mill Laborer	
	*Head Feeder	52
	*Head Runner	56
	*Mill Runner	67
	Washer	35-43
	Machinist	72-88
	Carpenter	70-74
	Surface Laborer	49
	Spare Hand	52
	Mason	74

*Positions not delineated in June 1885.

SOURCE: QMC, Cost Sheet, 1905 and "Scale of Wages in Effect, November 1st, 1905."

more specialization of labor in 1905 than in 1885, with thirty-two new jobs specified, not including the twenty distinct types of work done at the smelter. In most respects, however, there was remarkably little growth in specialization considering how much larger the workforce had become. Thirteen of the new positions identified in 1905 were on the Quincy and Torch Lake Railraod, which did not exist in 1885 and another seven jobs came from further articulation of the management structure. The total managerial and technical staff had grown from 22 in 1885 to 68 in 1905, roughly paralleling the growth in the overall size of the workforce. The enlarged scale of mining operations justified creating the specialized positions of Drill Sharpener, Drill Boy, and Lander, but these tasks were performed earlier as well. With the exception of the stamp mill and railroad, the occupational structure of 1905 was not very different from twenty years earlier for the simple reason that the technology used in mining, hoisting and rock handling had not changed enough to require new skills. The same can be said for the structure of wages in the two years. With few exceptions, the monthly wages paid in 1905 were about 50 percent higher than in 1885 for all major categories of work.. It is worth noting, however, that the Company broke radically with the past when it hired a female stenographer, Ethel Fisher in 1903.[106] If we ignore a few boardinghouse keepers who may have worked for the Company, she was probably the first female hired by Quincy to work in Michigan.

The ethnic characteristics of the workers changed dramatically in these years. In order to enlarge its workforce, Quincy as well as the other mines in the district had to attract large numbers of European immigrants. Employment in the Houghton County copper mines increased from 7,310 in 1890 to 16,250 by 1910, while total county population grew from 35,389 to 88,098. Although the share of foreign-born residents in the total fell between 1890 and 1910, their absolute numbers rose from about 17,000 to over 33,000.[107] The large influx of immigrants came predominantly from Finland, Italy, Austria, and Eastern Europe.[108] Quincy's workforce, which was still dominated by the Cornish, Irish, Germans, and French-Canadians as late as 1885, fundamentally changed by the turn of the century.

We can examine the ethnic composition of the workers during this period only indirectly. Beginning in the mid-1880's, the Company maintained a record card for each employee, issued when the person was first hired, indicating his place of birth, jobs held, and a variety of other social and demographic information. They kept the file current by discarding the records of those who left the Company prior to 1918, when an entirely new system was put into practice. The employment records of 2,400 individuals have survived and are a useful source of information on the workforce.[109] However, several notes of caution are in order. The records are a sample which may include only about one fifth of all the people who worked for the Company before 1918. The sample is almost useless for the period 1860-1889 as there are only 51 men accounted for. At the other extreme, there is information on 1,599 employees hired in 1910-1919, a period of enormous labor turnover due to the strike of 1913-1914 and later pressures brought by the wartime labor market. Because the sample does not include those workers who left during the strike, it probably underrepresents some ethnic groups, especially the Finns and Italians, who struck in disproportionate numbers.

The sample is marginally useful for the 1890's, but much better for the following decade. Had none of Quincy's 1890 employees been fired, quit, or died, the Company would have had to hire 872 new workers during the 1890's to achieve their 1900 employment level. It is more likely that they hired at least 1,200 new men during this decade and perhaps as many as 2,000. The sample of 195 workers may be as small as one tenth of the total. Under the same extreme assumptions of zero turnover, they would have hired 663 workers in 1900-1909. Even if the actual number was double that, our sample of 586 is impressive, if it were not subject to the limitations previously outlined. In spite of all these misgivings, the information from these records, summarized in Table 4.92, is valuable. Given the bias of the sample, the Finns may have comprised nearly half the workers hired in 1890-1909 and the Italians another fifth of the total.

The new immigrants were significantly different from the earlier migrants and had a different impact at Quincy and at the other mines in the district. Language was one obvious difference, for the earlier migrants either knew English or were quick to learn it.[110] The new migrants had rural agricultural roots, thus were unskilled in terms of mining. Ninety percent of the more than 200,000 Finns who

TABLE 4.92: ETHNIC ORIGINS OF QUINCY WORKERS, BY DATE OF FIRST HIRE, 1890-1909

	Foreign Born		First Generation Americans, By Parents' Place of Birth		
Place of Birth	1890-1899	1900-1909	1890-1899	1900-1909	TOTAL
Cornwall	36	47	13	21	117
Ireland	7	3	10	26	46
England, Scotland	11	13	3	12	39
Canada	12	19	8	13	52
Finland	55	256	-	21	332
Norway	2	3	1	3	9
Sweden	3	10	-	2	15
Italy	10	104	-	2	116
Germany	11	10	11	6	38
Croatia	1	15	-	-	16
Other	1	-	-	-	1
TOTAL	149	480	46	106	781

SOURCE: QMC, Employee Record Cards.

left their native land in 1893-1910 came from rural areas and a vast majority of these were engaged in farming.[111] The Finnish experience at Quincy and elsewhere in the copper district typifies the fate of the latecomers.[112] They invariably began working as trammers, underground laborers and general surface laborers, among the most demanding and poorly paid jobs at any mine.[113] Because of the barriers of language and culture, as well as outright discrimination, newcomers like the Finns were relegated to these unattractive positions, while the earlier generations of immigrants dominated mining, the skilled trades, and the managerial posts.[114] This occupational hierarchy constructed along ethnic lines added a new and explosive element to management-labor relations.[115]

Quincy's workers did not engage in any significant strike or other labor action between May 1872 and June 1890.[116] With the exception of a brief strike at the Calumet and Hecla Mine in January 1874, the entire Michigan copper district was similarly strike-free during these years. In contrast, there were at least seven distinct strikes at Quincy between 1890 and 1906. Some of the disturbances were part of district-wide labor unrest, as in 1890 and 1904, but most were peculiar to Quincy. There was, however, a general increase in scattered labor unrest throughout the district after 1890, so Quincy's workers (and management) were not unique in this respect.[117] The increased size of the Company's operations probably contributed to the labor unrest by depersonalizing worker-employer relations and increasing the barriers between managers and workers. Increased social divisions within the workforce and the community in general, one result of the changing ethnic character of the workers, also contributed to tensions. Although the available information of these strikes varies greatly in quality, it is nevertheless useful to examine the individual disputes.

Defensive strikes, i.e., actions designed to prevent wage cuts were not common at the mine. The Company reduced wages by ten percent in January 1885 and after intervening increases, again in August 1893 with no response from the workers.[118] The strike of June 1890 was typical of the types of action workers were taking during these years. Mason and Harris recognized in mid-April that their employees might strike for a pay increase because of the general prosperity of the industry and the presence of several Knights of Labor organizers in the Calumet area calling for a district-wide strike on May Day.[119] The situation at Quincy remained calm until late June, when workers struck several mines in the district, including Tamarack, Osceola, and Kearsarge.[120] Virtually all of Quincy's workers went out on June 23rd, demanding a 15% raise. Harris met with several workers' representatives and offered a general increase of 10 percent retroactive to June 1st, which they accepted. However, the trammers also demanded that five men be assigned to each tramcar, rather than the past practice of using four and Harris gave them some vague reassurances.[121] The surface workers returned to their jobs the next day, but the underground workers including miners stayed out another day because workers at the nearby Franklin Mine struck for a 20 percent increase.[122] The mine returned to normal by June 25th and Harris offered a suggestion for future labor peace in the district: "If the management of the several copper mines would use common sense enough to agree on some uniform scale of wages, and some concerted action in case of strikes, most of these—and all other labor troubles might be averted."[123]

The next major strike began in April 1896 and was the first of several actions spearheaded by trammers. They were in a relatively strong bargaining position even though they comprised only about ten percent of the entire labor force.[124] The mine simply could not operate without them and although they were unskilled, it was extremely hard to replace them on short notice. Quincy raised wages ten percent in August 1895, restoring the cut made two years earlier, in the hopes of avoiding the unrest which was occuring at other mines in the district.[125] The following April 23rd the trammers refused to work, demanding $2 a day ($52 a month) versus the $1.70 a day ($45 a month) that they were earning at the time.[126] The miners tried to do their own tramming for two days before quitting and by April 27th the mine was closed.[127]

Flexing their muscles, the trammers sent a delegation to Harris and repeated their demand for an increase to $2 a day. Harris countered by offering $50 a month and agreeing to increase the number of men on each tramcar from two to three, while simultaneously threatening to dismiss anyone who refused these terms. The trammers accepted the "compromise" on June 29th.[128] A relieved Mason referred to the crisis as "your struggles with the striking Northmen," suggesting that the trammers were mostly Finns.[129] Mason's solution to this labor unrest was simple: "And now don't forget to dismiss, as opportunity offers, the smartest of them—but take your own time and do it quietly."[130] Harris reported a few days later that he had already begun to fire the ringleaders.[131]

There was labor peace for nearly three years, followed by two brief general strikes in 1899 and 1900. In both cases, workers were demanding increased wages to counter the post-1896 inflation and to share in the Company's large profits.[132] In February 1899 several mines had raised wages by about ten percent and Quincy's workers were on the verge of striking for 15 percent.[133] There is no direct evidence of a strike, but the Company did increase wages by about 8% at that time.[134] The same inflationary pressures continued and after the Osceola miners had their monthly wages increased from $56 to $65 in April 1900, Quincy's workers demanded the same and struck in early May. The mine and stamp mills were closed for two weeks until the Company granted a general increase of ten percent.[135]

Wage levels remained virtually frozen in 1900-1903 and there were no labor disputes, but then the Company faced strikes in 1904, 1905, and 1906. J. L. Harris noted in April 1903 that trammers and other underground laborers were in short supply throughout the district.[136] However, by Christmas Eve, Todd proposed a general wage cut of ten percent to take effect early in 1904.[137] The actual wage cut which was announced in mid-January was a selective reduction (from $60 to $55 a month) which applied to trammers who had been replaced by the new electric haulage system, in effect demoted to the status of "laborer."[138] Even within the trammers' ranks, there was a differential impact, for the Italians clearly initiated the strike, were then joined by other trammers (Finns) and finally by the miners, entirely shutting down the mine for two weeks.[139] The trammers not only demanded a return to the previous wage rate, but also insisted on increases for underground laborers and rock-house workers, plus a return to the work rules (number of gangs of trammers) that had applied under hand tramming.[140] The strike was clearly an effort to blunt the wage and employment implications of the new electric tramming technology.

The settlement of the 1904 dispute was bizarre. An undated, unsigned "Memo Regarding Strike," probably written by Todd, accused J. L. Harris of gross incompetence in handling the entire matter. The strike shocked the New York office because Harris had assured them that the men would not resist the pay cut. Once the strike began, Harris initially insisted that the Company stay with the $55 offer, but then with no authorization from New York, he offered a self-proclaimed strike leader--and stooge named Marinelli a compromise of $57, which the men promptly rejected.[141] Todd, clearly annoyed by Harris' behavior, reluctantly agreed to offer $58.50, which was accepted.[142] The criticisms of Harris were numerous—he had failed to notify the men of the pay cut in advance, made an unauthorized, botched offer which reduced his credibility with the strikers and had then requested unlimited authority from New York to settle the dispute as he saw fit.[143]

There was a brief strike a year later over wages. On Saturday, March 18th, the Company announced a pay increase, with miners' wages advancing from $62 to $65 and trammers' wages going from $58.50 to $60 a month. The miners and trammers struck, but then met on Monday and voted to accept the new rates. Perhaps they were simply flexing their muscles to create the illusion that they had "won" the increases. At that point, the rockhouse men refused to work, demanding $52 a month and their action kept the mine closed. Harris quickly settled with them at $50 Monday night and the work stoppage then ended.[144] The ease with which the men won substantial increases in 1904 and 1905 probably encouraged them to try collective action again, which they did in July 1906 when there was a far more serious confrontation.

The strike of 1906 took place in an atmosphere noticeably different from a year earlier. After relatively easy success against J. L. Harris, the men now faced a new Superintendent who had taken control in December 1905 and probably wanted to demonstrate his toughness to both the New York office and the men. In February, the mine was rocked by a series of cave-ins, causing "air-blasts," which were not only destructive and disruptive, but created a wave of fear among the underground workers, although there were no deaths resulting.[145] Finally, on July 4th a Finnish-speaking organizer from the Western Federation of Miners appeared before Finns working for the Michigan Mine in Rockland and in a matter of days, these copper miners began a long bloddy strike.[146]

The underground workers at Quincy walked out on July 23rd and demanded an immediate ten percent wage increas. Lawton offered a raise of roughly five percent retroactive to July 1st, but the strikers held meetings in Hancock and on Quincy Hill and continued to insist on the larger pay raise. Lawton had decided to grant no further concessions and the Company Directors supported this stance.[147] The stalemate continued until August 14th when the workers met in Quincy Hall, under Company auspices and voted roughly 550-50 to return to work the following day.[148] This referendum included only about one third of the total workforce and roughly one half of the underground workers. The strike died and at the end of the year the Company voluntarily granted another five percent increase.[149]

The 1906 strike was fundamentally different from earlier labor disturbances. It was a far more sophisticated strike, for some of the workers established a committee which formulated a set of demands which they presented to the Company in writing. Lawton and Todd only acknowledged the pay issue, but the workers' committee made seven other demands on July 27th. They asked for a one year agreement, no recriminations against strikers, no changes in any other terms of employment, and the restoration of the traditional night shift differential by which men had worked three shifts, but were paid for four. More significantly, they made three demands relating to mine safety and offered an explanation for them:

> 2. We demand the following betterments in our laboring conditions, Viz:
>
> A. The trucks by which the men air hoisted shall be furnished with runners like those in the skip which prevent them to tumble from the tracks.
>
> B. The existing laws regulating the hoisting of the workers shall be strickly (sic) followed.

C. The water pipes in the mine shall be maintained in the same condition they were (in) before the air blasts.

D. We make the above mentioned demands regarding our own safety as fathers and sustainers of our families, because we understand that our position without (the) above mentioned betterments is dangerous.[150]

The records do not reveal how long this workers' committee survived or how representative they were. They made a point of immediately rejecting Lawton's pay offer and on July 30th asserted that they were the sole representative of all Quincy employees. Nine men signed the initial set of demands, but thirty-one had the courage to sign at least one of the statements. These included eighteen Italians, six Finns, three Germans, two Englishmen (possibly Cornishmen) and one Russian.[151] We can safely guess about their fate after the strike ended. The fact that this multi-ethnic committee was established suggests that the workers were beginning to overcome the barriers of language and culture which divided them and enabled the mining companies to dominate.

Labor relations at Quincy clearly deteriorated after 1890 as the Company grew and as the ethnic makeup of the workforce changed. The underground workers, particularly the trammers were the most militant and their concerns often went beyond the issue of wages. The nascent organization that surfaced in the 1906 strike indicates a growing sophistication on the part of the workers that did not bode well for the Company, even though the workers clearly lost this particular confrontation. There was relative labor peace at the mine for seven years, largely because the industry remained prosperous and wages remained high. The strike of 1906 demonstrated the potential for future protracted strikes under the right circumstances. The disastrous strike of 1913-1914 and the conditions which produced it will be the topic of a later chapter.

The Mature Company, 1905-1913

The brief period between the strikes of 1906 and 1913 was in many respects the era of greatest prosperity for the Company. These were the last years in which Quincy earned profits in a normal market, because during the war years which followed, unusually high copper prices practically guaranteed profits to any producer regardless of its efficiency. The Company then struggled to earn profits in the 1920's after copper prices collapsed, but with little success. The output and employment levels achieved in 1909-1911 were all-time records.

A closer examination of the pattern of investment during these years (Table 4.93) reveals a great deal about the firm's position. The total investment of nearly $2.8 million was substantial and seems comparable to earlier years, but $1.6 million of this was spent on three major real estate deals—lands bought from the Arcadian Copper Company in 1906 for $765,000; the purchase of the Franklin Mining Company properties in 1908 for $170,000; and the acquisition of additional lands from the St. Mary's Canal Mineral Land Company in 1910 for $600,000. A new stock issue accounted for $700,000 of the gross profits of 1906 and financed the land purchase of that year. If we exclude real estate, the Company was spending an average of about

TABLE 4.93: QUINCY MINING COMPANY, INDICATORS OF AGGREGATE PERFORMANCE, 1905-1913

	Total Workforce	Output of Copper (Tons)	Average Sale Price of Copper	Average Total Costs, Including Construction	Profits Per Pound of Copper	Gross Profits	Permanent Improvements and Real Estate	Net Profits	Dividends
1905	1,714	9,414	15.8¢	10.9¢	4.9¢	$1,104,484	$138,733	$ 965,751	$ 800,000
1906	N.A.	8,097	19.5	12.1	7.4	2,061,545	903,605	1,157,940	1,445,000
1907	N.A.	9,899	18.8	12.1	6.7	1,497,112	200,440	1,296,672	1,155,000
1908	1,965	10,300	13.6	11.5	2.1	608,765	154,605	454,160	440,000
1909	2,045	11,256	13.5	10.5	3.0	800,260	231,410	568,850	465,000
1910	2,019	11,259	13.2	10.5	2.7	754,603	261,910	492,693	495,000
1911	2,029	11,126	12.8	10.6	2.2	614,178	264,586	349,592	440,000
1912	1,993	10,319	16.4	11.8	4.6	1,110,823	260,049	850,779	605,000
1913	1,880	6,092	15.8	15.3	0.3	248,934	322,774	-73,840	247,500

SOURCE: QMC, Annual Reports, 1905-1913.

$133,000 per year during this period. There were few single investments of any great size except for the construction of the Number Nine (Pontiac) Shaft in 1908-1913 at a cost of nearly $161,000. If we exclude this figure and the $103,000 spent at the Quincy Smelting Works, the average level of investment fell below $100,000 a year.[152]

The purpose and nature of investments changed substantially from earlier periods. The Company was no longer making major, expensive changes in plant and equipment in order to utilize new technology. One major exception was the new steel rockhouse erected at Number Two Shaft in 1907. The plant and equipment at the mine, mill and smelter were upgraded by the addition of dozens of new pieces of machinery and equipment, but these changes did not fundamentally alter basic processes or practices. Lawton's report on construction projects undertaken in 1907 illustrates the kinds of investments the Company was making in this period. They built a new motor-generator there; bought a new boiler for the No. 2 boiler house; converted an old boiler house into a dryhouse and an older dryhouse into a power drill sharpening shop; added a new steam hammer to the blacksmith shop; modified the work floors of three shafthouses; overhauled an old compressor; added a new compressor house and compressor at the No. 8 Shaft; constructed sixteen new houses and repaired several others; modified one of the heads at the stamp mill; remodeled fifty-seven rock cars; built a machine shop at the smelter; and made about a dozen additional modifications to existing plant and equipment.[153] In a later report Lawton pointed out that most new construction involved replacing existing equipment and therefore should be viewed as an operating cost, reflecting the depreciation of plant and equipment.[154] This is a fair description of most of the investment made at the mine location during these years.

These unspectacular changes in technology were nevertheless significant in terms of reducing operating costs. One of Lawton's major concerns was to reduce fuel consumption and he was able to report an overall savings of 9,636 tons of coal in a single year, roughly one tenth of total consumption.[155] Similarly the costs of treating a ton of rock at the rockhouse fell from 6.5 cents in 1905 to 3 cents by 1909.[156] Given the total of nearly 1.4 million tons treated in 1909, this implies a total savings of over $50,000 a year. There were similar economies achieved in other vital operations—tramming costs fell by 3 cents a ton between 1907 and 1912, while hoisting expenses fell by 1.6 cents per ton in 1907-1910 alone.[157] Lawton was also able to increase the capacity of the stamp mills by about forty percent between 1906 and 1909 with only minor expenditures.[158]

One major part of the Company's Michigan operations had been immune from technological change since the 1880's—the mining process itself. However, in 1911-1913, Lawton introduced several experimental air drills to replace the heavy two-man drills which had been used for decades.[159] These new lightweight drills required only one operator and their introduction was an important issue in the strike of 1913. This innovation and its impact will be considered in detail in a later chapter.

By sharply cutting costs in many areas at the mine, mills, and smelter, Quincy was able to stabilize its overall costs of production during these years, no mean achievement. In his report for 1907, Lawton summarized the principal challenges the Company faced:

> Many reasons have conduced to increase the cost of the production of copper at the mine; among which may be cited the greater depth of the workings; the subterranean disturbances; the lessening of contents of metal in the rock, due to increased amount of lower grade rock that it has been found profitable to stamp; to the narrower mineral lodes being worked, and to the higher cost of labor, materials, and all supplies.[160]

In 1906, the deepest shaft (Number Two) reached about 5,300 feet measured on the incline, but by 1913 four of the five shafts were 6,000 feet deep and Number Two had reached a depth of about 6,400 feet.[161] The richness of the rock they were finding continued to decline, but more slowly than earlier. The amount of ingot copper produced from each ton of rock mined had fallen sharply from 31 pounds in 1897 to 18 pounds in 1904 and by 1913 had reached about 15 pounds per ton.[162]

As a result of the "air blasts" which began in 1906, the Company had to adopt a variety of new underground practices to stabilize the ground in the old workings. They also changed the ways in which they developed the mine ahead of stoping and experimented with the more costly "retreating system" of stoping.[163] As a result of these changes, the Company had to push development work (shaft-sinking and drifting) further ahead of stoping than in the past and beginning with the Annual Report For 1909, they listed their development costs separately.[164] For the years 1909-1912, development costs amounted to over $200,000 per year and were about one-tenth of the Company's total expenditures in all operations.[165] In this way the Company continued to commit considerable resources to investment in the mine, roughly double their spending on surface plant and equipment.

Their acquisition of additional real estate also represented a long-term investment to insure the continued operation of the mine in future decades. In 1896 Quincy had purchased the land on which they erected the Number Eight (Mesnard) Shaft, but it could be extended to a depth of only 2,500 feet before crossing onto lands owned by the Arcadian Copper Company. Quincy did not show much interest in the Arcadian property until the fall of 1906, when the Directors offered $500,000 for 800 acres. Quincy already owned the SE ¼ of Section 13, but wanted the rest of the Section, plus the N ½ of the adjoining Section 18, Range 33, where the northernmost section of the Pewabic Vein outcropped.[166] Todd had begun negotiations with A. C. Burrage, President of the Arcadian.[167] After a special meeting of their stockholders, the Arcadian management asked $750,000 for the lands, which the Quincy Directors agreed to.[168] They financed the purchase by selling 10,000 shares of new stock at $70 a share, raising the total shares outstanding to 110,000.[169]

Quincy also bought the Franklin Mining Company lands in 1908 after coveting them for more than two decades. Once they had purchased the Mineral Company lands to the west in 1893, Franklin could no longer function as a mine and Quincy wanted to buy it after they had acquired the Mesnard property in 1896. Franklin was in the middle and Quincy considered using one of the old Franklin shafts to exploit the Mesnard deposits. In the first half of 1898, Quincy and Franklin discussed a sale, but could not come to terms. Harris urged Todd to pay as much as $150,000 for the Franklin, but the issue was dead by March 1899.[170] The possibility of buying Franklin was not seriously discussed again until March 1903, when J. L. Harris suggested that they send rock from the Mesnard workings through the Franklin property to Quincy's Number Six Shaft via electric tramming and thus avoid building a new hoist at the Mesnard Shaft.[171] Harris revealed that Quincy had already trespassed on Franklin by extending its drift at the 43rd Level through to the Mesnard workings.[172] Quincy was negotiating with Franklin for permission to do what had already been done years before, i.e., pass through the Franklin lands. Harris was not worried that Franklin would sue Quincy if they discovered the trespass because Franklin had trespassed extensively on the Mesnard property.[173]

The Franklin property became an issue again in March 1907 after Mr. Burnham of Burnham, Bennett and Company of Boston offered the Quincy Directors control of the Franklin Mining Company if they would buy 15,000 shares of Franklin stock. The Quincy Directors offered to buy only 3,000 shares, but authorized Todd to negotiate the purchase of the old Franklin mine for no more than $150,000.[174] The two parties agreed on a sale price of $170,000 in November 1908, finally ending a source of great irritation for Quincy.[175] The purchase included the old Franklin Mine (SW ¼ of Section 24), but more importantly, a strip of Section 25 which extended to Portage Lake right next to the Quincy Smelting Works, thus providing badly needed room for expansion there.[176]

The Company made two additional land deals in this period. In 1910 they bought 800 acres from the St. Mary's Canal Mineral Land Company for $600,000, to be paid in four equal installments of $150,000 over the years 1910-1913. The Mineral Land properties, the NE ¼ of Section 22 and all of Section 14, provided additional ground which would eventually be reached by the No. 2, 6, 8, and 9 shafts. Finally, in 1913 they bought 440 acres from John A. Roebling's Sons, portions of Sections 27 and 28, Township 55, Range 33, located just west of the Quincy Stamp Mills on Torch Lake.[177]

Quincy was prosperous in 1905-1913 because its production costs remained well below the price of copper, but the Company had become a relatively high cost producer compared to its chief competitors. A survey of production costs at seventeen major mines in 1901 showed total costs per pound of copper ranging from a low of 7½ cents (Wolverine Mine) to a high of 14 cents (Tamarack Mine). Quincy, with costs of 10½ cents, was among the high cost mines, with only four other producers higher. The mines with costs equal to or below Quincy's were large producers by comparison and accounted for 87 percent of the combined output of the seventeen firms.[178] Quincy earned comfortable profits with copper at 13 cents and above, but would not have fared well in a less buoyant, more competitive market, with 10 or 11 cent copper. Even though the years prior to the 1913 strike appeared prosperous, there were underlying economic problems which ultimately surfaced in the 1920's.

Management and Labor, 1906-1913

The changes in the New York and Michigan managerial ranks which had begun with Mason's death in 1899 were completed before the First World War. The management team which would run the Company until the mine closed in 1931 was in place on the eve of the 1913 strike. The same was true for the business and managerial practices developed in 1906-1913. These were years of peaceful labor relations at the mine, but the labor force continued to change and began to develop several characteristics which would contribute to long-range labor problems which continued through the 1920's.

The first few years of William Rogers Todd's Presidency were marked by serious internal battles within the ranks of the Directors and between the Directors and Todd. In the early part of 1906 and again in 1907, some major stockholders wanted to replace Todd at the helm.[179] The old problems with discontented Boston stockholders surfaced again in May 1907, when they enlarged the Board from eight to nine members and elected William. M. Belcher of Boston to the new seat.[180] The Directors then split on geographical lines in a devisive August vote on dividends, with the New York interests narrowly winning.[181] When Dr. Daniel Brigham, a Boston Director died in July 1908, Todd wanted to strengthen his forces on the Board by putting Lawton in the vacant seat.[182] This touched off considerable internal debate in which several Directors discussed among themselves a variety of candidates including Colonel Thomas Livermore, a Vice President of the Calumet and Hecla Mining Company, Lawton, W. Parsons Todd, Alfred L. Ripley, who was President of the State National Bank of Boston, and Austin Wheelock, also from Boston.[183] They finally reached a near-consensus on J. Monroe Longyear, a Bostonian who had gained the support of six of the eight surviving Directors by November. They delayed electing him until February 1909 to placate Isaac Meserve, who was the Company's second largest stockholder and vehemently opposed Longyear. Kirchner described Meserve as "ignorant, choleric, and resentful."[184] A year later Kirchner conceded that electing Longyear, who never attended Board meetings, had been a mistake.[185]

The selection of new Directors was controversial because the Board still had considerable control over the Company, partly because Todd had not yet solidified his position, but also because his health was questionable. He had been ill for much of November 1909 and on December 7th had his prostate gland removed by Dr. Bolton Bangs in New York City, in an operation that the younger Todd described as routine.[186] James L. Bishop, an important Boston Director, thought differently:

> I think that from the nature of the operation (upon the prostate gland) that it will thus be very doubtful whether Mr. Todd will ever again be very active in business. We are thus having brought pretty close to us the question of the management of the company in the event of his retirement.[187]

In the same breath he suggested that Quincy consider merging with Calumet and Hecla.[188] Bishop was not alone in believing that Todd's retirement (if not his death) was imminent, for the Directors voted Todd a gift of $10,000 in November 1909 in recognition of his long dedicated service to the Company.[189] The elder Todd not only recovered from his operation, but continued to serve as President until his death in June 1924 at the age of eighty-seven.

Todd gradually solidified his control of the Company through a variety of actions. His son became a Director in 1911 and was named Vice President a year later. Walter P. Bliss, who had held that position since 1904, had earlier taken the extraordinary act of returning his entire Vice President's salary to the Company because he felt he had not earned it.[190] The rest of the New York hierarchy did not go through any radical change. William A. O. Paul, who had served as Assistant Secretary-Treasurer from 1897 until 1902, when he was promoted to Secretary-Treasurer, remained in this post. Beginning in November 1912, the Mine Clerk Frederick J. McLain served as Paul's assistant.[191] They also continued to elect the Company's attorney to the Board, a practice begun with Thomas B. Dunstan in 1901. He was followed by Don M. Dickenson, the firm's General Counsel between 1902 and 1906, and then by James L. Bishop who held this position until 1924.[192] The Company was almost continuously involved in litigation during these years and therefore wanted a permanent legal advisor on the Board.[193]

Todd continued arranging all sales of Quincy copper directly with customers. They were the only large producer to do this, but as a result maintained the status of their copper as a "special brand."[194] They made long-term sales agreements with large customers, but with some price flexibility built into them. In February 1907, the Company had signed a contract to deliver 90,000 pounds of copper to the National Brass and Copper Company of Lisbon, Ohio at 25½ cents, but by November, this customer requested that the price be adjusted downward because market prices were falling. The Directors authorized Todd to settle the matter and he agreed to fulfill the contract at 20 cents a pound.[195] However, the most important function of the New York office was to oversee the Michigan management, a job that was perhaps more important during these years than ever before because of the disastrous relationship New York had experienced with J. L. Harris.

Charles Lawton did not begin his tenure as Superintendent on a very promising note, but the disasters of 1906—the "air blasts" of early February and the month-long strike during the summer—were not his fault. The Company initially gave Lawton a one-year contract extending to December 1, 1906, providing him with a salary of $10,000, the free use of the Superintendent's residence, and a variety of other perquisites.[196] The Directors must have been satisfied with his work because they followed with a three-year contract effective January 1, 1907, which provided a substantial raise to $15,000 per annum.[197] However, Lawton and Todd often clashed and in June 1913, on the eve of the strike, the Directors gave Todd blanket authority to dismiss Lawton and choose a successor whenever he felt this would be in the Company's best interest.[198]

There was no explanation for this action and Lawton was never removed, except by his own death more than three decades later.

In his first few years in power, Lawton developed a management team which remained essentially intact through the late 1920's. Frederick J. McLain became Mine Clerk in 1904 and held the post for two decades.[199] There was also considerable stability in the underground mining management. In spite of the criticisms Todd had leveled against him, Thomas Whittle remained as Chief Mining Captain until his death in 1912, when he was replaced by Charles Kendall, who served until 1920. Beginning around the turn of the century the mine was divided into two distinct segments, each supervised by a Captain. Shafts 2, 4, and 7 were called "South Quincy" and were run by Captain George Jacobs until 1912 and by Captain Thomas Maunders from 1912 on. Charles Kendall supervised "North Quincy" (Shafts 6 and 8) until he became Chief Captain in 1912, at which time Jacobs took over North Quincy.[200] In 1905, there were an additional fourteen underground supervisors, alternately called "Undercaptains" or "Shaft Captains". Lawton reduced this force to six by 1916 and only one of the fourteen (Maunders) survived the housecleaning.[201]

Despite the charges that J. L. Harris had filled the middle management ranks at the mine with overpaid incompetent cronies, there was no wholesale change in personnel after Lawton took control. The key individuals who survived until at least 1916 included T. W. MacDonald (Surface Boss), John Berryman (Boss Blacksmith), Louis Lanouette (Railroad Yardmaster), and William Oxnam (Rockhouse

Boss). There were several cases of promotions from within the existing middle-level management ranks. Alfred W. Lord, the Railroad Superintendent since 1890, was in effect retired and given the job of Railroad Clerk and his son A. J. Lord took his place as Superintendent. Peter Audette, a carpenter foremen since 1902, was promoted to Boss Carpenter sometime after 1905. Only two significant Harris appointees were replaced—Walter Bloomfield lost his position as Supply Clerk to R. D. Blackburn in 1907 and the Master Mechanic W. M. Gilliland was replaced by A. C. Butler.[202]

Lawton's responsibilities extended beyond Quincy Hill. James W. Shields was the Superintendent of the Stamp Mills from 1902 on, but he reported to Lawton and was under his general supervision. At the same time, however, the Quincy Smelting Works continued to operate independently of the mine and Lawton.[203] The first Superintendent of the smelter, James R. Cooper treated Quincy mineral on a contract basis for five years ending in November 1902, when Will P. Smith took his place and the Company formally took control of the plant. Smith resigned in June 1908 and his successor, Alexander Laist ran the smelter until 1927.[204] Although Lawton could not dictate smelter practices or policies, there was a constant need to integrate all of the Michigan operations—mine, railroad, stamp mills and smelter—for the sake of overall efficiency. Interruptions in the delivery of mineral or significant changes in its quality would create severe problems at the smelter. In his early years at Quincy, Lawton claimed to have significantly improved the coordination of the Michigan operations, but did not specify how.[205]

At the same time that the Michigan management was changing, there were also several key changes in administrative responsibilities and practices at the mine. The treatment of mine safety and employee accidents underwent a fundamental change. Michigan had established a system of County Mine Inspectors in 1887, but these were appointed by the County Commissioners until 1911. In Houghton County and other areas where the mining companies dominated the political structure, the result was a series of Mine Inspectors who did nothing more than record fatal accidents.[206] When accidents resulted in deaths or crippling injuries, the Company generally denied any legal liability. The injured party would typically receive benefits from informal, voluntary subscriptions from the other workers.[207] After the electrocution of a trammer in early 1905, Quincy's underground workers began agitating for money compensation from the Company for injuries and for the election of Mine Inspector.[208] Safety was an important issue in the 1906 strike as well. Fatal accidents were on the rise, partly because of the larger number of employees, but also because of the changed ethnic makeup of the workforce which created severe communications problems underground. Accidental deaths averaged 2½ a year in 1893-1899, then rose to 6 a year in 1900-1906 and to 10 per annum in 1907-1912, with Finns making up more than half the victims.[209]

The growth in fatal accidents produced a few suits against the Company, but more significantly, made it more likely that they would face extensive litigation in the future. When Michigan enacted a

Workman's Compensation Law in 1912 providing specified rates of compensation for accidents to employees of participating firms, Quincy immediately agreed to join the system and paid slightly more than $34,000 into the accident insurance pool in 1912 to provide coverage for its workforce of 2,000.[210] They simultaneously decided to appoint an engineer to serve as Safety Inspector, whose major duty would be to develop and enforce rules and regulations to improve underground safety.[211] Within a few months, they had renamed this post "Safety and Efficiency Engineer" and finally named H. L. Chamberlain to fill it in May 1913.[212] In later salary lists, he is shown simply as an Efficiency Engineer. In 1914 they were active in the "Safety First" movement, teaching first aid to their workers and requiring a physical examination for all prospective employees.[213]

The Company also rationalized its payroll system in 1913, largely as a result of State legislation requiring that workers be paid twice a month. In the same year they introduced a time card system for all employees, including miners, adding timekeepers who relieved Mining Captains of much of their record-keeping responsibilities. They also ended the practice of paying the men at the mine office and instead paid them at the shaft.[214] Lawton's success in cutting back the number of Assistant Captains was probably the result of these changes. The conversion to numbered time cards for each employee reflected and symbolized the growing impersonalization of Company-employee relationships that was inevitable as the mine became a large-scale operation. Virtually all

Quincy workers had become day laborers well before 1913, but punching the same time card made it impossible for even the miners to maintain the myth that they had a unique status.

Beginning around 1905 the mine management became significantly more bureaucratic and began to generate an explosion of paper records. The clerical and technical staff grew substantially, although it remained tiny by contemporary standards. In 1900 they required six Clerks or Assistant Clerks, one Chief Engineer and one Assayer to manage the mine and stamp mills in addition to the operations staff. To be sure, Captains and Bosses were keeping a variety of records at that time. By contrast, in 1916 they employed eight clerks, three timekeepers, ten general office workers, three telephone operators, and eight assayers or engineers (excluding steam engine and boiler "engineers"), for an administrative staff of thirty-two.[215]

The workforce continued to grow during these years and exhibited additional changes in occupational and ethnic composition. Table 4.94 summarized the major categories of workers in 1905 and 1912. The overall growth of the labor force of 16 percent exceeded the 10 percent increase in output between these years. The share of underground workers in the total labor force continued to rise because of the greater depths of working and increased emphasis on development work and the growing number of Timbermen reflected the increased underground reinforcing necessitated by the "air blasts." In 1912, there were only a handful of new occupations not explicitly recognized in 1905, including eighteen "Motormen and Trainmen," thirteen men who cleaned or repaired the tramraods, five electricians,

TABLE 4.94: OCCUPATIONAL DISTRIBUTION OF THE QUINCY LABOR FORCE, 1905 AND 1912

	1905	1912
Underground		
Miners	594	683
Landers & Trammers	287	275
General Laborers	209	313
Timbermen	45	116
Others	34	74
TOTAL	1,169	1,461
Surface		
Rockhouse Laborers	65	44
General Laborers	61	36
Skilled Workers	120	122
Others	64	40
TOTAL	310	242
Railroad Workers	59	70
Stamp Mill Workers	139	186
Others	37	34
GRAND TOTAL	1,714	1,993

SOURCE: QMC, Cost Sheet For 1905 and Force Employed, 1908-1920.

and five "Pony Boys."[216]

It is difficult to determine the ethnic composition of the workers with much precision because of the enormous labor turnover during and immediately after the 1913 strike. Quincy hired about 1,600 new employees in the 1910's (two-thirds were foreign-born), even though the total workforce declined from 2,045 in 1909 to 1,646 in 1919.[217] The new employees were even more diverse in terms of their ethnic backgrounds than earlier immigrants—the Company recognized thirty-four distinct countries of origin for these new arrivals.[218] However, most of them were hired after the beginning of the strike in July 1913. A list of underground employees on May 1, 1914 shows 522 "new men" of a total of 978 who were working. Of the force of 197 trammers at work, only eight were pre-strike employees.[219] The impact of the strike can be seen from the ethnic character of the workforce, summarized in Table 4.95 below. First and second generation Finns and Italians compromised 54 percent of all new workers hired between 1900 and 1919, but by May 1914 they made up less than one quarter of a much smaller workforce, suggesting that the strike must have decimated their ranks. Since virtually all of the nearly 1,200 Finns and Italians who were hired in 1900-1919 probably came to Quincy before 1913, they may have comprised one third of the entire workforce and perhaps one half the underground force before the strike.

Finnish and Italian immigrants started at the bottom of the occupational hierarchy and had few prospects for advancement because the older immigrants, especially the Cornish and Irish, mon-

TABLE 4.95: NATIONALITY OF QUINCY WORKERS, May 1st, 1914

	Number	Share of Total (%)
Americans	31	2.2
Cornish/English	271	19.6
Germans	205	14.8
Finns	173	12.5
Italians	167	12.1
Russians	154	11.1
Poles	111	8.0
Frenchmen	64	4.6
Irishmen	62	4.5
Austrians	44	3.1
Canadians	35	2.5
Swedes	22	1.5
Others	27	1.9
TOTAL	1,376	

SOURCE: QMC, "Nationality of Underground Workers, May 1, 1914" and "Nationality of Stamp Mill and Surface Employees, May 1, 1914."

opolized the more desirable jobs. A list of sixty-five supervisory and technical personnel in 1916 includes Cornish, Irish, Scottish, German and even an occasional French surname, but not a single Finn or Italian.[200] These supervisors, including Captains, Bosses and Foremen simply preferred their fellow countrymen and so discriminated against others when hiring. For underground workers, upward mobility meant becoming a miner or timberman, while on the surface, mobility was achieved by moving into the ranks of machinists, blacksmiths, carpenters, railroad workers, and boiler, compressor and hoist operators.

From the turn of the century onwards, neither the "new" immigrants nor their children moved up the occupational ladder in large numbers. We have detailed occupational histories for 165 Italian immigrants hired after 1900. Fourteen of them began in the skilled positions listed above and only six more moved into those occupations during their employment. For a smaller sample of nineteen first generation Italian-Americans, the results were much the same, with only four ever holding one of the better jobs. The Finnish experience was worse in some respects, for their mobility seems to have worsened over time. Of 36 Finns who were hired in the 1890's and remained with Quincy, 21 eventaully became miners. However, of the total of 135 Finnish immigrants hired in 1900-1909, sixteen began in the skilled positions, but only thirteen more ever moved up. The next generation did not fare much better. Quincy hired 212 Finnish-Americans after 1900, probably the children of the earlier immigrants. Only 21 of these ever became miners and another 34 eventually held one of the more desirable jobs.[221] Besides, much of the mobility that these groups achieved came after 1913, when the Company experienced severe labor shortages and high rates of labor turnover.

Assessing the overall performance of the Company and its management for the period covered by this chapter is problematic. It is easy to be greatly impressed by the Company's growth and prosperity and the apparent wisdom of its leaders, particularly Mason and Todd. At the same time there is a temptation to see Quincy's success as the inevitable consequence of the technological innovations pursued aggressively from the late 1880's onwards. Both views are attractive, but seriously in error. There were major defeats and disappointments as well as victories during these years. For example, Quincy's stategy for acquiring needed real estate was often short-sighted, irrational, and counter-productive, thus unnecessarily costly. The same can be said for the relationship between several Quincy Presidents and the Michigan management during much of this era.

At the same time, we need to recognize the enormous risks that were involved in introducing new technology and expanding the mine during these years. In the final analysis, the Company's success depended on the continuation of the Pewabic Vein to unprecedented depths with sufficient richness to pay for the massive investments that were made. To a large extent, the growth which took place reflected the faith that Quincy's managers and stockholders placed in the Pewabic Vein. They were sometimes disappointed, as at the extreme ends of the formation, but overall their faith was rewarded. The Pewabic Vein held up at great depths, a geological fact which could neither be predicted nor altered by the acts of men.

[1]The major expenses on the Pewabic property (Number Six Shaft) included the hoisthouse and hoisting engine ($67,270), boilerhouse ($36,992), compressor and compressor building ($15,514), rockhouse $37,694), and shaft-sinking $159,920). For the Stamp Mill, the major expenditures were the mill building ($182,451), stamping machinery ($64,000), boiler plant ($47,151), pumping plant ($81,530), dock and warehouse ($30,186), and housing ($31,955). QMC Journal, 1887-1890, pp. 98, 215, 355, 492 and Journal, 1891-1897, pp. 135, 262, 391.

[2]The major items of expense at Number Two were the reconstruction of the shaft ($23,454), a new hoisthouse and hoisting engine ($90,229), and the shaft-rockhouse ($40,767). QMC, Journal, 1891-1894, p. 515 and 1895-1898, p. 136.

[3]The total of $3 million includes $800,000 for the Pewabic lands and an additional $550,000 for the Mineral Company lands purchased in 1893. For Quincy's total investment in 1847-1887, see Q.M.C., Annual Report For 1887, p. 7.

[4]QMC, Journal, 1887-1890, pp. 98, 215, 355, 492; 1891-1894, pp. 135, 262, 391, 515; 1895-1898, pp. 136, 268, 406.

[5]QMC, Annual Report For 1894, p. 5.

[6]Expressed in terms of costs per ton of ingot copper, transportation expenses fell from $8.17 in 1887 to $5.18 in 1897. See QMC, New York Journal, 1872-1893, p. 179 and 1894-1905, p. 84.

[7]The percent yield of mineral from each ton of rock treated, taken from the Annual Reports, 1887-1892 was:

1887	3.23%
1888	3.04
1889	2.82
1890	2.19
1891	1.64
1892	1.33

[8]The share of mass and barrel copper in total ingot output, taken from the Annual Reports, 1887-1900 was as follows:

1887	11.6%	1894	33.8%
1888	9.7	1895	31.0
1889	18.3	1896	30.3
1890	33.9	1897	33.2
1891	39.6	1898	32.6
1892	44.8	1899	32.6
1893	41.2	1900	33.0

[9]Beginning in 1894, the Annual Reports refer to "Product from rock houses" instead of "Product of Mass copper," reflecting the practice of separating and treating all mass copper as well as barrel work at the shaft-rockhouses. To be sure, large masses had always been segregated from the other rock, but there was a separate building at the old stamp mill for treating barrel copper, equipped with eight head of stamps to separate the copper from the surrounding rock. It seems likely that before 1890 barrel copper was counted as "stamp rock," while after that date it was added to the figures for mass copper. In fact, a new steam hammer was added to the rockhouse in 1890 expressely for treating barrel copper. See QMC, Annual Report For 1890, p. 12.

[10]QMC, Journal, 1887-1890, p. 92 and Cost Sheet For 1897, p. 8.

[11]These technological improvements are discussed at great length in Larry Lankton's report on mining technology.

[12]Standardized, preprinted Cost Sheets in booklet form have

survived for 1893-1905. The data were collected monthly and then brought together in annual summaries.

[13]QMC, Cost Sheet For 1897, pp. 1, 2.

[14]This shaft-rockhouse was averaging 4.5 tons per skip raised when in first appeared in the accounts. See QMC, Cost Sheet For 1895, p. 16.

[15]Rock tonnage per skip jumped to 3.4 tons in 1898 and reached 4.4 tons in 1899. See QMC, Cost Sheets, 1898 and 1899.

[16]In 1888 both shafts (Two and Four) were approximately 3,000 feet in depth. By 1900, Number Six was at 4,700 feet, Number Seven at 4,200 feet, and Numbers Two and Four at about 4,000 feet.

[17]S. B. Harris to Mason, 16 September, 1891.

[18]Ibid., 30 January 1892.

[19]QMC, Directors' Minutes, Directors' Meeting of 11 December 1893.

[20]QMC, Annual Report For 1893, p. 6. Here, Mason refers vaguely to one shaft which was approaching the boundary, but it was almost certainly Number Two.

[21]Ibid., pp. 6, 7.

[22]QMC, Annual Reports, 1893-1897, passim.

[23]QMC, Annual Report For 1897, p. 10.

[24]S. B. Harris to Mason, 21 April 1894. The fact that Harris wrote a detailed three page letter on the matter suggests that Mason was more than casually interested in the Franklin property.

[25]Annual Report of the Commissioner of Mineral Statistics For The State of Michigan for 1880 (Landing, 1881), p. 140 and ibid.,

Report For 1882 (Lansing, 1883), Table of Copper Production for 1855-1882.

[26]Harris to Mason, 21 December 1895.

[27]QMC, Directors' Minutes, Directors' Meeting of 17 January 1895.

[28]Harris to W. R. Todd, 28 July 1896 and QMC, Directors' Minutes, Directors' Meeting of 9 November 1896.

[29]Harris to Mason, 10 December 1896. In the Annual Report For 1897, p. 6, the cost of the Mesnard lands is given as $38,560. This higher figure reflects either legal costs or the expense of solving the unexpected title disputes.

[30]For a more detailed explanation of the complex issues and events which finally led to the decision to build a smelter on Portage Lake, see Cathy Silverstein's H. A. E. R. Report on Quincy's smelting operations prior to 1898.

[31]QMC, Day Book, 1856-1857, pp. 12, 13, 23; New York Journal, 1857-1872, passim; and Annual Reports, 1861-1872, passim.

[32]Gates, Michigan Copper, p. 43.

[33]Mason to Harris, 16 April 1884.

[34]W. R. Todd to Harris, 21 April 1886.

[35]James B. Cooper, "Historical Sketch of Smelting and Refining Lake Copper," Proceedings of the Lake Superior Mining Institute, VII (1901), p. 47.

[36]Gates, Michigan Copper, p. 73.

[37]Cooper, "Historical Sketch," pp. 46-47.

[53]The ten largest stockholders and the shares held—Mason and Smith (10,092), Francis C. Welch and Howard B. Daniels (3,748), George Bliss (\$2,500), Charles J. Devereaux (2,250), Isaac H. Meserve (2,127), John Blackie (865), Mary Wallace (670), Richardson, Hill and Company (587), George S. Hyde (400), and Howard B. Daniels (364). From QMC, "List of Stockholders, 15 March 1894."

[54]George T. Bliss and his son Walter served from 1896 through 1924; Charles J. Devereaux was a Director in 1897-1921 and his son Charles B. in 1921-1930; Cleveland Dodge served from 1897 to 1911; and Isaac Meserve from 1898 to 1920. See Annual Reports, passim.

[55]QMC, Directors' Minutes, Directors' Meeting of 1 June 1892.

[56]In June 1904, for example, the 100,000 shares of Quincy stock outstanding were spread among approximately 2,000 stockholders, but the eleven largest held 38,811 shares, an effective majority for most purposes. These large stockholders and the number of shares held—the Mason family (9,865), the Meserve family (7,000), the Bliss family (5,000), F. B. Weatherby (3,871), John Brown (3,286), the Daniels family (3,000), Elizabeth Bernard (2,110), the Adams family (1,530), M. C. Wallace (1,340), Samuel B. Harris (1,005), and the Chesterton family (1,004). QMC, Stockholders' Minutes, Meeting of 1 June 1904.

[57]Ibid., Meeting of 7 June 1899.

[58]QMC, Directors' Minutes, Directors' Meeting of 1 December 1902.

[59]Quincy's methods of selling copper are discussed in detail in Lawton, "Review," pp. 24-26.

[60]Gates, Michigan Copper, pp. 76, 85-89.

[61]S. B. Harris to W. R. Todd, 28 February 1899.

[62]Ibid., 8 March 1899.

[63]"Certificate of Award, for Specific Merit, by the World's Columbian Commission to the Quincy Mining Company," 1893.

[64]"Certificate of Award, United States of America, Universal Exposition, St. Louis, MDCCCCIV, Commemorating the Acquisition of the Louisiana Territory, to the Quincy Mining Company," 1904.

[65]QMC, Directors' Minutes, Directors' Meetings of 3 July, 1888, 15 July 1893, and 2 June 1897.

[66]Ibid., Meeting of 1 June 1892.

[67]Ibid., Meeting of 7 June 1893.

[68]Daily Mining Gazette (Houghton, Michigan), 19 October 1927, p. 3.

[69]S. B. Harris to W. R. Todd, 2 March 1892.

[70]Ibid., 7 March 1892.

[71]QMC, Directors' Minutes, Directors' Meeting of 1 June 1892 and S. B. Harris to W. R. Todd, 14 July 1892.

[72]S. B. Harris to T. F. Mason, 8 August 1892.

[73]Ibid., 13 August 1892 and 3 September 1892.

[74]S. B. Harris to Armitage Benedict, 11 October 1899.

[75]S. B. Harris to W. R. Todd, 30 June 1890.

[76]Ibid.

[77]S. B. Harris to Armitage Benedict, 10 August 1900.

[78]S. B. Harris to W. R. Todd, 11 August 1900.

[79]Charles J. Devereaux to W. R. Todd, 19 August 1900.

[80] *Ibid.*

[81] *Ibid.*, 26 February 1901.

[82] *Ibid.*

[83] W. R. Todd to S. B. Harris, 15 June 1901.

[84] W. R. Todd to J. L. Harris, 10 July 1902.

[85] QMC, *Directors' Minutes*, Directors' Meeting of 15 January 1900.

[86] *Ibid.*, 21 July 1900.

[87] J. L. Harris to W. R. Todd, 13 August 1902 and W. R. Todd to J. L. Harris, 18 August 1902.

[88] *Ibid.*

[89] QMC, *Directors' Minutes*, Directors' Meeting of 4 June 1902.

[90] *Weekly Mining Journal*, (Marquette, Michigan), 1 January 1897, p. 4.

[91] QMC, *Directors' Minutes*, Directors' Meeting of 7 June 1899.

[92] W. R. Todd to S. B. Harris, 20 May 1902.

[93] J. L. Harris to W. R. Todd, 12 July 1902.

[94] *Ibid.*, 17 August 1902.

[95] *Ibid.*

[96] Charles J. Devereaux to W. R. Todd, 30 September 1902.

[97] J. L. Harris to L. B. Sutton, 14 November 1902.

[98] QMC, *Directors' Minutes*, Directors' Meeting of 1 December 1902.

[99] J. L. Harris to L. B. Sutton, 15 February 1903.

[100] *Ibid.*

[101] *Ibid.*

[102]QMC, _Directors' Minutes_, "Agreement Between the Quincy Mining Company and Charles L. Lawton, June 27, 1905."

[103]_Report of the Hancock Consolidated Mining Company For the Year_ 1917, n.p.

[104]_Hancock Evening Journal_, 3 November 1903 and the _Daily Mining Gazette_, 23 July 1946, p. 1.

[105]Quincy Smelting Works, _Cost Sheet For 1906_ contains the first detailed list of smelter employees.

[106]The first reference to a stenographer is in the _Cost Sheet For 1903_, but Ms. Fisher first appears in a wage list for December 1905. It was probably not a coincidence that Daniel Fisher (a relative?) was an Assistant Clerk at the time.

[107]Gates, _Michigan Copper_, pp. 209, 229.

[108]_Ibid._, pp. 106-107.

[109]Cathy Silverstein painstakingly gathered all of the data I am using from these records, including dates of hire, ethnic origins, and job mobility.

[110]Gates, _Michigan Copper_, pp. 114-115, discusses this problem at the Calumet and Hecla Mining Company.

[111]John I. Kolehmainen and George W. Hill, _Haven in the Woods: The Story of the Finns in Wisconsin_ (Madison, 1965), pp. 152-153 gives a detailed breakdown of the occupational background of Finnish migrants.

[112]For the history of Finnish migration and the Finnish experience in America see: A. William Hoglund, _Finnish Immigrants in America, 1880-1920_ (Madison, 1960); Ralph J. Jalkanen, Editor,

The Faith of the Finns: Historical Perspectives on the Finnish Lutheran Church in America (Lansing, 1972) and The Finns in North America: A Social Symposium (Lansing, 1969); John I. Kolehmainen, The Finns in America: A Bibliographic Guide to Their History (Hancock, Michigan, 1947); John I. Kolehmainen and George W. Hill, Haven in the Woods: The Story of the Finns in Wisconsin (Madison, 1965); Clemns Niemi, The Americanization of the Finnish People in Houghton County, Michgian (Duluth, 1920); Carl Ross, The Finn Factor in American Labor, Culture and Society (New York Mills, Minnesota, 1977); and John Wargelin, The Americanization of the Finns (Hancock, Michigan, 1924).

[113]Hoglund, Finnish Immigrants, pp. 62-64. For the decade 1900-1909, we know the first jobs held by 127 Finns. Only eleven began as miners and one as a timberman, while 75 were underground laborers, another 15 were trammers, and the rest began as general surface workers.

[114]For a discussion of this development throughout the entire Michigan copper district, see Gates, Michigan Copper, pp. 114-115. For the Finnish experience with job discrimination, see Hoglund, Finnish Immigrants, pp. 58-64. It is ironic that at Quincy, Finns did not have much upward mobility into the better positions until after the strike of 1913, for which they were in large part responsible.

[115]Gates, Michigan Copper, p. 107, suggests that the mine owners consciously recruited a variety of new ethnic groups in the belief that the new immigrants would be tractable and that ethnic

diversity would forestall unionism and labor unrest generally. Their belief was ill-founded, to say the least.

[116] Ibid., pp. 113-114.

[117] Ibid.

[118] W. Hart Smith to S. B. Harris, 10 January 1885 and S. B. Harris, to T. F. Mason, 22 August 1893.

[119] T. F. Mason to S. B. Harris, 14 April 1890 and Harris to Mason, 16 April 1890.

[120] S. B. Harris to T. F. Mason, 21 June 1890.

[121] S. B. Harris to W. R. Todd, 23 June 1890.

[122] Ibid., 24 June 1890.

[123] Ibid., 25 June 1890.

[124] The QMC Cost Sheet For 1896 lists 133 trammers and landers out of a total workforce of 1,042 at the mine and stamp mills.

[125] S. B. Harris to T. F. Mason, 19 August 1895.

[126] Ibid., 23 April 1896.

[127] Ibid., 24, 25, and 27 April 1896.

[128] Ibid., 27, 28, and 29 April 1896.

[129] T. F. Mason to S. B. Harris, 30 April 1896.

[130] Ibid.

[131] S. B. Harris to T. F. Mason, 4 May 1896.

[132] Gates, Michigan Copper, p. 109 compares miners' wages with general price movements in the 1890's.

[133] S. B. Harris to W. R. Todd, 14 February 1899.

[134] Miners' wages, a good barometer of overall wage movements, increased from $52,50 a month in 1898 to $56.72 in 1899.

[135]S. B. Harris to W. R. Todd, 8 May 1900 and "Some Causes of the Increased Cost of Mining for 1900," n.d. The average monthly wages paid to miners rose from $56.72 in 1899 to $62.00 in 1900.

[136]J. L. Harris to W. R. Todd, 4 April 1903.

[137]W. R. Todd to J. L. Harris, 24 December 1903.

[138]J. L. Harris to W. R. Todd, 17 and 26 January 1904.

[139]<u>Ibid</u>., 18 January, 26 January, and 2 February 1904 and QMC, <u>Annual Report For 1904</u>, p. 12.

[140]J. L. Harris to W. R. Todd, 23 January 1904.

[141]<u>Ibid</u>., 5 February 1904 and "Memo regarding Strike" in QMC, Directors' Minutes, 1904.

[142]"Memo regarding Strike."

[143]<u>Ibid</u>.

[144]J. L. Harris to A. W. Leonard, 7 April 1905.

[145]The "air blasts" were so important that Lawton devoted four pages in the <u>Annual Report</u> For 1906 discussing their effects.

[146]Ross, <u>The Finn Factor</u>, pp. 95-97.

[147]QMC, <u>Director's Minutes</u>, Directors' Meeting of 8 August 1906.

[148]The chronology is taken from an undated summary of the strike prepared by "F.J.M.," probably the Mine Clerk, Frederick J. McLain.

[149]QMC, <u>Annual Report For 1906</u>, p. 8.

[150]List of demands, with the heading, "To The Quincy Mining Company," dated Hancock, Michigan, July 27, 1906.

[151]These documents were attached to McLain's chronology of the strike, so they reached the mine office, although he does not refer to them explicitely.

[152]The *Annual Reports* for these years list the work at Number Nine and at the Smelter separately, but give no details for the remaining investments.

[153]QMC, *Annual Report For 1907*, pp. 9-14.

[154]QMC, *Annual Report For 1909*, p. 12.

[155]QMC, *Annual Report For 1907*, p. 15.

[156]QMC, *Annual Report For 1909*, p. 15.

[157]QMC, *Cost Notebooks*, *1907-1912*, passim.

[158]QMC, *Annual Report For 1909*, pp. 18-19.

[159]QMC, *Annual Reports For 1911*, pp. 12-13; *For 1912*, p. 14; and *For 1913*, pp. 14-15.

[160]QMC, *Annual Report For 1907*, p. 9.

[161]QMC, *Annual Reports For 1904*, *1913*.

[162]Calculations of yield for the period 1897-1923, probably compiled by Lawton.

[163]QMC, *Annual Report For 1907*, p. 14

[164]QMC, *Annual Report For 1909*, p. 6.

[165]QMC, *Annual Reports For 1909-1912*, *passim*.

[166]QMC, *Directors' Minutes*, Directors' Meeting of 8 October, 1906.

[167]W. R. Todd to A. C. Burrage, 3 September and 7 September 1906, and C. D. Burrage to W. R. Todd, 12 September 1906.

[168]Francis W. Kittredge to W. R. Todd, 5 October 1906 and QMC, *Directors' Minutes*, Directors' Meeting of 19 November 1906.

[169]QMC, *Annual Report For 1906*, pp. 5-7.

[170]S. B. Harris to W. R. Todd, 22 January, 4 February, 13 April, and 23 May 1889 and 20 March 1899.

[171]J. L. Harris to W. R. Todd, 20 March and 23 March 1903.

[172]Ibid., 28 March 1903.

[173]Ibid., 14 April 1904.

[174]QMC, Directors' Minutes, Directors' Meeting of 4 March 1907.

[175]Ibid., Meeting of 16 November 1907.

[176]QMC, Annual Report For 1908, p. 6.

[177]QMC, Annual Report For 1910, pp. 6-7, 14. This land contained no known or suspected mineral deposits and the surviving records do not explain the purchase.

[178]Boston News Bureau, XLIV, No. 92, 27 April 1909, p. 1. The seventeen firms specified in this article had a combined output of 361,000 tons of ingot copper, or roughly two-thirds of total American production. At this point, the Michigan mines still compared favorably with their rivals in Utah, Arizona, and Montana. Calumet and Hecla (8¼ cents per pound) and Copper Range (9¼ cents) were among the lowest cost mines.

[179]James E. Bishop to Otto Kirchner, 19 January 1906 and Kirchner to Bishop, 16 January and 21 January 1907. These and subsequent letters to and from Kirchner are in the Kirchner Papers in the Burton Historical Collections of the Detroit Public Library. A prominant Detroit resident, Otto Kirchner served as Quincy's Michigan Director in 1907-1920. Bishop, a New York attorney, was a Director from 1904 to 1924.

[180]W. R. Todd to Otto Kirchner, 24 April and 28 May 1907.

[181]Ibid., 30 August 1970.

[182]Ibid., 2 July 1908.

[183]Kirchner to James L. Bishop, 3 July 1908; Colonel Thomas L. Livermore to Kirchner, 14 July 1908; James L. Bishop to Kirchner, 21 July and 20 October 1908; and Kirchner to Walter P. Bliss, 28 January 1909. Bishop, Bliss, and Kirchner were all Directors.

[184]Kirchner to Colonel Thomas L. Livermore, 14 November 1908.

[185]Kirchner to Walter P. Bliss, 8 March 1910.

[186]W. Parsons Todd to Kirchner, 9 December 1909.

[187]James L. Bishop to Kirchner, 9 December 1909.

[188]Ibid.

[189]QMC, Directors' Minutes, Directors' Meeting of 10 November 1909.

[190]Ibid., Meeting of 25 November 1907.

[191]Ibid., Meeting of 19 Novmeber 1912.

[192]Ibid., Meeting of 24 November 1924.

[193]In 1907, for example, the Company was involved in suits relating to changes in Michigan mining law, Quincy's tax assessment in Osceola Township, and a Federal Court restraining order preventing a Quincy tenant from tieing his boats at the Quincy Dock at Portage Lake. There is extensive correspondence and briefs on these cases in the Otto Kirchner Papers, Burton Historical Collections, Detroit Public Library.

[194]W. R. Ingalls, "How the Metals Are Sold—Copper," Engineering and Mining Journal, Vol. 93, pp. 887-888.

[195]QMC, Directors' Minutes, Directors' Meetings of 25 November 1907 and 13 February 1908.

[196]"Agreement, Quincy Mining Company and Charles Latham Lawton, 27 June, 1905."

[197]"Agreement, Quincy Mining Company and Charles Latham Lawton, 14 February, 1907."

[198]QMC, Directors' Minutes, Directors' Meeting of 4 June 1913.

[199]After the mid-1890's, the Annual Reports rarely mention major personnel changes at the mine. For this segment on the Michigan management I have relied heavily on salary lists generated in 1900, 1902, 1905 and 1916.

[200]AMC, Annual Report For 1912, p. 20.

[201]QMC, Salary Lists of November 1905 and December 1916.

[202]Ibid.; QMC, Employee Contracts, 1 August 1902-1 August 1903; and J. L. Harris to William Oxnam, 30 January 1903.

[203]The Smelting Works maintained a separate set of books and paid for all of its materials and labor. The Superintendent of the Smelting Works reported directly to the President and not to the Mine Superintendent. There is no indication that Lawton was even consulted with regard to any decision made at the Smelting Works, including the appointment of the Superintendent there.

[204]Will P. Smith to W. R. Todd, 1 May 1908 and QMC, Directors' Minutes, Directors' Meeting of 12 May 1908.

[205]QMC, Annual Report For 1907, p. 16.

[206]Most of the material on mine safety is taken from Sharon C. Park, "Underground Safety at the Quincy Mine Until 1915," unpublished term paper, May 1978.

[207]J. L. Harris to Hanchette and Lawton, 29 July 1904.

[208]J. L. Harris to W. R. Todd, 22 February 1905.

[209]Park, "Underground Safety," Appendix A summarizes the fatal accident reports given in the Houghton County Mine Inspector's Annual

Reports for 1892-1915.

[210]QMC, Annual Report For 1912, pp. 5-7.

[211]QMC, Directors' Minutes, Directors' Meeting of 19 November 1912.

[212]Ibid., Meetings of 25 February 1913 and 15 May 1913.

[213]QMC, Annual Report For 1914, pp. 12-20.

[214]QMC, Annual Report For 1913, pp. 19-20.

[215]QMC, Salary Lists for 1900, 1916.

[216]QMC, "Force Employed," 1908-1920.

[217]QMC, Employee Rocord Cards for employees hired in 1910-1919.

[218]Of the total 1,043 immigrants, the largest groups were the Finns (427), Italians (126), Russians (60), Cornishmen (51), Poles (51), Croatians (43), Germans (42), Austrians (39), French-Canadians (35) and a hodgepodge of others including Danes, Swiss, Turks, and Mexicans.

[219]QMC, "Underground Employees, May 1st, 1914: Old and New Men."

[220]QMC, "Quincy Mine Salary List, Christmas 1916."

[221]All of the data on mobility were complied from the employee record cards by Cathy Silverstein.

CHAPTER FIVE: STRUGGLE AND DECLINE

The Company was shaken to its foundations by the long bitter strike that began in July 1913 and although it "won" the strike, this marked the beginning of severe labor shortages that plagued the mine for the rest of its working life. After Quincy returned to normal operations in the middle of 1914 there were five highly profitable years until copper prices collapsed in early 1920. The entire decade which followed was a long unsuccessful period of struggle to earn profits ending with the onset of the Depression, which forced Quincy to shut down its Michigan operations in 1931. The Company resumed production in 1937, but produced at a loss until September 1945 when they closed the mine permanently. To a large extent market conditions beyond the control of the Company determined its fate. More than at any time in Quincy's history, its management cannot be praised or condemned very strongly for the successes and failures of these years. The one exception involves the extent to which the outcome of the strike determined later performance.

The Strike of 1913-1914 and Its Impact

Thousands of undergound workers throughout the Michigan copper district went out on strike on July 23, 1913 at the call of the Western Federation of Miners and Quincy's workers joined the strike action. The bitter, devisive and often violent struggle which followed did not officially end until April 14, 1914, but the mining companies had effectively defeated the strikers by December

1913. The dozens of significant events in this strike, many clouded in mystery and controversy are treated elsewhere and I will make no effort to examine the strike in its entirety here.[1] The underlying issues in the dispute were ambiguous in some respects. The Western Federation demanded pay increases, an eight-hour day and a minimum wage, but their insistence on recognition for the union and a prohibition of the one-man drill seemed far more significant to both sides. For their part the mine owners saw Western Federation unionization as the only issue and they adamantly refused to negotiate with the Western Federation representatives.[2]

The impact of the strike on Quincy and the Company's reactions to it were not noticeably different from those of the other major producers. The mine was entirely shut down for ten days, but underground operations did not resume on even a limited basis until August 22nd, nearly a month after the strike began. In the meantime the Michigan National Guard had arrived in the copper district and by early August there were over five hundred troops quartered on Quincy Hill protecting Company property and preventing strikers from intimidating the men who wanted to work. The National Guard remained there until November 15th, but a large force of deputy sheriffs and private guards remained on duty until May 1914. Like the other producers, Quincy broke the strike by importing large numbers of workers from outside the district. Between September 19th and the end of the year they brought in about 525 new men, mostly Russians, Poles and Germans. It was not until early December that all three major production shafts were operating at anything resembling "normal" conditions.[3] Even with these imported men, there were only 1,200 at work in January 1914, compared to the pre-strike workforce of nearly 2,000. Operations were then disrupted by a series of air blasts which began in late March. By the middle of May the total labor force was nearly 1,500 and the mine returned to normal production levels.[4]

In the short-term the effects of the strike were disastrous. Copper production, slightly over 10,300 tons in 1912, fell to 6,092 tons in 1913 and improved only marginally to 7,678 tons in 1914. Only when production returned to normal in 1915 did the Company earn significant profits. There were no dividends paid from September 1913 until December 1914, then they declared a nominal one of $55,000, but in 1915 stockholders received $880,000.[5] The longer-range effects of the strike, however, were far more significant.

For the Company, defeating the strikers meant that they could proceed with the introduction of the one-man drill. After additional experiments with the drill in 1913, Lawton had one hundred of the new machines delivered in February 1914.[6] The impact on the productivity of miners, thus on costs and profits (see Table 5.1) was impressive. The reduction in the number of miners, directly attributable to the one-man drill, accounts for the entire reduction in the workforce between 1912 and 1916. The small increase in total costs was a great achievement considering the general increase in prices and costs in the American economy during these years. Quincy's wage costs, for example, increased substantially—

TABLE 5.1: QUINCY MINING COMPANY AGGREGATE EMPLOYMENT, COSTS AND PROFITS, 1912 and 1916

	Output of Copper (Tons)	Total Employment	Miners Employed	Sale Price of Copper, Cents Per Pound	Profit Margin Per Pound	Gross Profits
1912	10,319	1,993	683	16.4¢	11.8¢	$1,089,674
1916	10,523	1,646	363	25.6¢	12.6¢	2,785,779

SOURCE: QMC, _Annual Reports For 1912, 1916_.

miners' daily wages rose from $2.70 in May 1912 to $3.87 by July 1916 and there were similar increases for other employees.[7] The relatively slow rise in costs during these years is also remarkable when we take into account the simultaneous decline in the levels of experience and skill among underground workers.

Quincy was able to reap the benefits of the one-man drill and extraordinary copper prices for a brief period after the strike. Copper sold at 25 cents and above in 1915-1918 and the Company enjoyed record profits as a result.[8] These relatively easy earnings disappeared when when copper prices fell off abruptly and the Company was unable to bring its costs into line with the new market realities. This shift in fortunes, summarized in Table 5.2 below, marked the end of the Company's long record

TABLE 5.2: QUINCY MINING COMPANY COSTS AND PROFITS 1916-1923 (Cents Per Pound of Copper)

	Average Sale Price	Average Total Costs	Profit Margin
1916	25.6¢	12.6¢	13.0¢
1917	28.6	17.5	11.1
1918	24.4	20.4	4.0
1919	19.8	18.0	1.8
1920	16.7	19.6	-2.9
1921	13.5	15.2	-1.7
1922	14.5	15.0	-0.5
1932	15.3	17.5	-2.2

SOURCE: QMC, Annual Reports For 1916-1923, passim.

of profits and dividends which had earned it the nickname "Old Reliable." Dividend Number 127, paid in March 1920 was the last one the stockholders enjoyed until after the Second World War. Their unsuccessful struggles to earn profits in the 1920's will be taken up later in this chapter.

During the buoyant war years and shortly thereafter the Company made its last large-scale investments in physical plant and equipment. They spent nearly $1.3 million on improvements in 1917-1921 or roughly $250,000 a year. The most spectacular and expensive investment was the new hoist and hoisthouse at the Number Two Shaft, completed in 1920 at a cost of $371,000. In addition they built several boardinghouses, about sixty new houses and a brick Clubhouse (bathhouse) for the employees, involving expenditures of $237,500 in 1916-1918. There was an almost continuous upgrading of equipment at the Stamp Mills, including a major addition in 1918.[9] Understandably, investment fell off abruptly in 1922 and then averaged only about $75,000 per annum in 1922-1927. With hindsight, one could argue that the investments of 1917-1921, particularly the construction of the hoist at Number Two were excessive, but this is an unfair judgement based on our knowledge of subsequent developments.

The Company also bought additional real estate to prolong the life of the mine. They acquired eighty acres, mainly in the SE ¼ of Section 22, from the Hancock Consolidated Mining Company in 1915 for $226,250.[10] In 1919 they bought an additional 140 acres (also in Section 22) from the same company for $251,624.[11] In both cases, they were trying to insure that there would be plenty of additional ground which could be worked from the Number Two and Seven Shafts. Their decision to buy these lands and to build the massive hoist at Number Two reflects the Company's optimistic perceptions of its long-run prospects. By 1917, when Number Two had reached a depth of 7,000 feet they were quickly approaching the capacity (7,500 feet) of the 1894 hoist which was serving this shaft.[12] Its replacement, which was finally put into service in 1920 had a capacity of 13,000 feet of wire rope and could have easily served this shaft for two decades, even if they had extended it at a rate of two hundred feet a year.

A final legacy of the strike was a severe shortage of labor which continued through the 1920's and affected all the major producers in the district. Thousands of men left the district or quit mining as a result of the strike and once the First World War began high wages in industrial centers like Detroit attracted a lot of miners, while the draft cut into the labor force at the same time. The Michigan copper mines were able to retain workers reasonably well through 1916, in part because of labor unrest and depressed conditions in the iron mining districts of Lake Superior, but by 1917 they began to have serious problems maintaining an adequate workforce.[13]

The Company's <u>Annual Reports</u> for 1917 onwards are filled with references to extreme labor shortages, high turnover rates and the inefficiency and high costs resulting from an inexperienced underground workforce. Quincy hired 2,525 new workers in 1917 but was able to enlarge its labor force by only ninety men.[14] The

Company enlisted the aid of labor recruiting agencies in Minneapolis, Chicago, and Wisconsin, but they were so worried about hiring I.W.W. sympathizers that they used the Pinkerton Agency to screen potential employees before sending them to the mine.[15] Throughout the years after 1917, the specific problem was a shortage of experienced miners and underground workers generally.[16] Lawton described the state of the Quincy workforce in 1920:

> . . .the rank and file of common labor on the surface, and especially the transient labor underground, continued to be shiftless, indifferent and exceedingly inefficient. The labor turn-over was large, and at all times it was very difficult to maintain a balanced force underground, either within itself or in cooperation with the several surface departments.[17]

Quincy and the other Michigan mines probably would have faced labor shortages during the First World War in any event, but the strike's devasting effect on the experienced labor force that was in place in 1913 certainly contributed to the problem.

The Struggles of the 1920's

Quincy's Annual Reports of the 1920's tell essentially the same story: "Due to the light demand and continued low prices at which copper has sold during the past year, it has been impossible to operate the mine at a profit notwithstanding every effort to reduce expenses."[18] Between 1920 and 1931 they managed to earn small gross profits (excluding investment) only in 1924 ($5,411) and 1925 ($50,635), which were entirely wiped out by investment expenditures. To be sure, they reduced the deficits significantly, from $530,741 in 1920 to $65,831 in 1922, but the losses then jumped to $278,825 in 1923 before further reductions were made. Beginning in 1926 the losses were staggering until they closed the mine in 1931. Simultaneously, copper production fell from about 9,600 tons in 1920 to 6,500 tons in 1923 and then stabilized at roughly 7,000 tons in 1924-1926.[19] This was a return to the production levels of the early 1890's when Quincy was beginning its great period of growth.

The simple inesacapable fact was that the Company could not produce copper at a cost below the price determined by the international copper market. They made desperate efforts to bring their costs into line with the new realities, but to no avail. For example, they cut wages nearly in half between December 1920 and August 1921, but labor costs remained too high. The situation became desperate in 1921, when the mine operated only four days a week for most of the year and Todd was seriously considering a variety of extreme solutions, including a complete shutdown. He asked Lawton to consider entirely closing one or more shafts and increasing the workday from eight to nine hours.[20] They reduced costs substantially but not fast enough to catch tumbling copper prices (see Table 5.2) and nevertheless decided to keep the mine open, hoping that the depressed prices were only temporary.

These fundamental problems were made worse by the continuing shortages of miners and other underground workers. They were forced to import hundreds of new men each year just to slow down the erosion of the workforce. In 1923 alone, the Company import-at least 724 new men. These efforts were not terribly successful, for the workforce fell from 1,646 in 1919 to 970 by 1923.[21] Next to the broad question of cost reductions and losses, the labor shortage became the Company's greatest concern in the early 1920's. They dealt with several dozen domestic and foreign labor recruiters in an effort to solve the problem and the Company's correspondence includes more than a thousand letters on labor recruitment in 1920-1923 alone. In fact, the issue helped cause a severe rift within the Company's management. At a Directors' Meeting held in March 1924 Todd delivered a blistering attack on Lawton's overall performance as Superintendent, citing Lawton's disastrous effort to import Mexican miners as one example of his incompetence.

Todd apparently believed that Lawton was responsible for the continued losses or at least felt that he was a convenient scapegoat. His unrestrained attack on Lawton was precipitated by a detailed report that the latter submitted to the Board:

> Although the detailed report furnished us on mining drills and steel in use is valuable and should be acted upon in due time, it is not in my opinion just now absoluetly necessary to do anything, the matter being of secondary importance to other things. A poor workman always grumbles with his tools.
>
> The chief and most important matter to consider just now is how to continue in successful operation and meet expenses with present equipment. In other words, how to reduce the cost of production and meet the market selling price of copper. This we must do or else close down and throw all employees, except those required to care for the property, out of employment. It is a very serious matter, for to shut down would probably entail a greater loss than to continue work, and besides, it is very questionable if closed whether the property would ever again be operated.

> I believe (that) with good, and efficient and judicious management present operations may be continued successfully. A certain celebrated painter was once asked 'What do you mix your paints with?' and he answered 'With Brains.' Now, that is what we need at the mine, a man that can realize and understand market conditions and work in harmony with the eastern office, capable and determined to meet and overcome all obstacles successfully. The question is, how to accomplish this. Until it is done other matters can wait to be taken up in their order of importance.[22]

Todd probably realized later, after some reflection, that Lawton was doing his best, for there was no effort to fire him.

To make matters worse, the mine was hit by several costly disasters in the 1920's. There was a series of air blasts in and near the Number Six Shaft in July 1922, Feburary 1923 and November 1924, disrupting production and draining manpower. The last of these produced damages which cost about $40,000 to repair.[23] These were relatively minor compared to the events of 1927, when a fire developed in the Number Two Shaft on July 13th, closing the shaft until August 10th. As repairs began, the mine was rocked by a series of air blasts which continued intermittently throughout the workings for six months, producing extensive damage. The mine was shut down for more than a year, with normal operations not resuming until March 1929.[24]

The fire and air blasts of 1927 could have resulted in the permanent closing of the mine. Production, summarized in Table 5.3, did not recover until 1930, just in time for the Great Depression. Taking into account the "Company's "normal" losses before these disasters, the catastrophic drop in output created

TABLE 5.3: QUINCY OUTPUT OF INGOT COPPER, 1925-1930 (Tons)

1925	7,179
1926	6,645
1927	4,859
1928	610
1929	2,230
1930	5,470

SOURCE: QMC, Annual Reports For 1925-1930, passim.

an immediate financial crisis which could be solved only through a major infusion of new capital. Repairing the damages and reopening the mine would not have been possible otherwise. In January 1928 the Directors increased the capital stock from 110,000 to 150,000 shares, selling the new stock to current shareholders at $12.50 a share, thus raising $500,000 quickly.[25] At the end of October, they increased the stock by an additional 50,000 shares which were offered at $25.00 each. The second issue was fully subscribed and paid by July 1929, raising an additional $1.25 million in badly needed funds.[26] To repair the damages caused by the air blasts and to reopen the mine using the "retreating system," Quincy spent a total of $1,625,000 by the end of 1929.[27] This last burst of investment was particularly tragic in light of the subsequent closing of the mine in 1931.

The brief time between the restoration of the mine in 1929 and late 1931, when the impact of the Depression had become all too apparent, was filled with considerable optimism about Quincy's future. Many of the Company's officers had made personal sacrifices in the late 1920's in an effort to reduce the overall operating expenses. W. Parsons Todd, who became President after his father's death in June 1924, had drawn no salary from 1926 on, W. A. O. Paul had done the same since 1927 and Lawton had accepted salary cuts amount to $16,000 for 1925-1959. Meeting in April 1929 and June 1930, the Company Directors confidently promised to repay all of these officials from future earnings. However by the end of February 1931 they hastily revoked these committments and by June were further cutting salaries of all the officers.[28] The optimism of the management extended to the stockholders as well, at least for a while. As a special meeting held on November 22, 1929 the stockholders authorized a further increase in the Company's stock from 200,000 to 250,000 shares. The Directors offered 30,000 shares at $25.00 in April 1930 with payment due in October and were still reasonably successful, selling 25,421 shares which brought in an additional $635,525.[29]

However, as the economic crisis worsened, so did the Company's overall financial position. The copper market simply collapsed with prices falling from 18 cents a pound in 1929 to 8 cents in 1931.[30] With losses of $456,000 in 1930 and approximately $325, 000 the following year, they were forced to close the mine on September 22, 1931.[31] A severe financial crisis had already developed when the Company was unable to repay a loan of $150,000 which fell due on July 15, 1931 and the bank (First National of Boston) refused to renew it. They were able to escape bankruptcy when Henry G. Lapham agreed to guarantee the loan and the bank gave Quincy a two-year extension. The grateful Directors rewarded

Lapham with 1,500 shares of stock in return for his favor.[32] The short-term crisis continued because the funds needed to maintain the property (about $90,000 a year) simply could not be raised through loans or sale of additional stock. Todd proposed a reorganization of the Company as the only solution and his plan was adopted at a Stockholders' Meeting of June 1, 1932. They issued 250,000 shares of new stock to be exchanged for the existing shares, with a par value of $25.00, but a paid-in capital of only $20.00, thus making each share subject to a maximum assessment of $5. According to Todd's estimates, an assessment of fifty cents a share would be sufficient to maintain the property for a year.[33] Without this desperate measure, the Company almost certainly would have been forced into bankruptcy in 1932.

Revival and Closing, 1932-1945

The Company's history during the worst part of the Depression is shrouded in mystery because there were no Annual Reports issued during the years 1931-1936. The mine remained closed, with a small staff performing a few repairs and guarding the property. The fundamental problem was the price of copper, which fell below 6 cents a pound in 1932 and then recovered slowly to 9½ cents in 1936.[34] A financial statement of the Company's operations in 1936 reveals much about the conditions of 1932-1936. Total expenditures at the mine amounted to $60,787 in 1936, with a payroll of $20,295 and another $24,661 spent on supplies. Total Company expenditures including the New York office were nearly $82,000 but revenues from sales of copper, rents and sales of materials amounted to only $17,320. At the end of the year the Company still had outstanding bank loans of $148,500, probably the same loan they could not repay in 1931.[35] They covered the costs of maintaining the property in 1932-1935 by levying an assessment of fifty cents a share each year. However, of the total of nearly 220,000 shares outstanding, 67,583 shares were forfeited to the Company for non-payment of assessments after an effort to sell them in 1935 failed. At most, they were able to raise about $75,000 a year to maintain the property. It is also clear from the later Annual Reports that the Company was unable to pay taxes on much of its Michigan property during those difficult years and lost some of the less important lands through tax sales.[36]

A significant improvement in copper prices in late 1936 prompted the Company to resume operations. In late September the Directors levied an assessment of $2.50 a share for the express purpose of reopening the mine. Todd reported at the end of the year that prices had jumped from 9 7/8 cents to 12 1/8 cents in three months and that they were hoping to begin mining by March 1937. They had already begun to purchase supplies, unwater the mine and begin work on underground repairs. By years' end, they had already prepared the Number Six Shaft down to the 84th Level and were pumping out the remaining territory which extended to the 91st Level.[37] The decision to reopen seemed well-founded, for Lake copper was selling at over 14 cents a pound by May 1937.[38]

Bringing this complex physical plant back into service proved to be far more difficult and expensive than anticipated. Fortunately, the Company collected the $2.50 assessment on about 152,000 shares, giving them about $375,000 of working capital. Between October 1937 and the following May, "Resumption Expenses" came to over $313,000 including almost $40,000 just to remove water from the mine. Extensive repairs were needed underground, as well as for the entire complex of surface machinery, railroad, and Stamp Mills. Although the reopening was extensive as well as costly, it by no means represented a return to the scale of operations of the 1920's. Only the Numbers Six and Eight Shafts were put back into service, leaving the other shafts idle. The two operating shafts began production in June and total output reached 2,122 tons in 1937.[39] Production doubled in 1938, the first full year of mining and remained above 4,000 tons per annum through 1941.[40] There were approximately 600 men employed once the mine reopened, a little more than one quarter of the peak levels of 1909-1911.

The mild optimism of 1937 and 1938 did not last because copper prices did not increase enough to cover operating expenses, much less depreciation. The Directors were forced to call in the last possible assessment of 50 cents a share in 1939 to cover operating losses. Beginning in late 1940, copper was subject to price controls which became increasingly rigid in 1941 and 1942. All the copper producers were paid a base price of 12 cents a pound, but a complex pricing system evolved, based on costs of production and quotas.[41] Quincy was receiving twenty cents a pound by the end of the war, a price barely sufficient to cover operating costs and depreciation. One result of the Federal Government's efforts to increase copper output was the Metals Reserve Company's loan to Quincy to finance the construction of the Reclamation Plant on Torch Lake in 1942. This facility opened in November 1943, recovering copper from the waste sands deposited there since 1890, and by the end of the war, it produced more copper than the mine.[42]

The Company was able to continue operating during the war years only because the Metals Reserve Company guaranteed Quincy twenty cents a pound for its copper. When their contract with Metals Reserve expired on August 31, 1945 the Company could receive only 17 cents a pound under the existing price control system. Since this lower price did not cover their operating expenses, the Company closed the mine on September 1st.[43] In the Annual Report For 1945, W. Parsons Todd optimistically noted that the mine would reopen when copper prices increased enough to make the operation profitable. However, this would never come to pass and Todd probably knew it, at least subconsciously. He paused briefly to recall the Company's long and distinguished history:

> It is unfortunate that after almost a hundred years of operation it should have become necessary to discontinue mining operations at the Quincy property. The first explorations for copper were made in 1846, and the earliest entry in the record books of the Company is of a meeting held at Marshall, Michigan, on November 17, 1846. The early explorations for copper were not successful, but mining men continued and with the opening of the Pewabic Lode in 1858 the Company entered a long period of profitable mining operations on this lode. The first dividend was paid in 1862 and they continued regularly for almost sixty years. The total dividends paid being $27,002,500 and a total of 848,083,134 pounds of copper have been produced.[44]

[1]There is considerable literature on the strike of 1913-1914. Some of the more important works include: William Beck, "Law and Order During the 1913 Copper Strike," Michigan History, LIV (Winter 1970), pp. 275-292; Copper Country Commercial Club of Michigan, Report of the Investigation Into Strike Conditions in the Copper Mining District of Michigan (Calumet, October 1913); Vernon H. Jensen, Heritage of Conflict: Labor Relations in the Non-Ferrous Metals Industry Up To 1930 (Ithaca, 1950); Philip E. Medlyn, "The Michigan Copper Strike of 1913-1914," Masters of Education Thesis, Wayne State University, 1963; William A. Sullivan, "The 1913 Revolt of the Michigan Copper Miners," Michigan History, XLIII (1959), pp. 297-314; G. R. Taylor, "The Clash in the Copper Country," The Survey, XXXI (1913), pp. 127-135, 145-149; Innis Ward, "The Reasons Why the Copper Miners Struck," Outlook, CVI (January 1914), pp. 274-181; United States Department of Labor, Bureau of Labor Statistics, Michigan Copper District Strike, Bulletin No. 139, February 7, 1914.

[2]Gates, Michigan Copper, pp. 132-133.

[3]QMC, Annual Report For 1913, pp. 11-14.

[4]QMC, Annual Report For 1914, pp. 11,12.

[5]QMC, Annual Reports For 1912-1915, passim.

[6]QMC, Annual Report For 1913, p. 15.

[7]QMC, "Wage Changes, 1905-1921," no date. Over the same period, daily wages for trammers went from \$2.55 to \$3.21 and surface laborers' wages rose from \$1.85 to \$2.00.

[8]For 1915-1918, gross profits amounted to \$6.8 million and dividends were \$5.56 million.

[9] QMC, Annual Reports For 1917-1921, passim.

[10] QMC, Annual Report For 1915, pp. 6, 11-12.

[11] QMC, Annual Report For 1919, p. 7.

[12] QMC, Annual Report For 1917, p. 17.

[13] Gates, Michigan Copper, pp. 134-138.

[14] QMC, Annual Report For 1917, pp. 6-7, 12.

[15] Charles L. Lawton to W. R. Todd, 2 April, 4 April and 27 April, 1917.

[16] QMC, Annual Report For 1918, pp. 7, 12.

[17] QMC, Annual Report For 1919, p. 12.

[18] QMC, Annual Report For 1921, p. 6.

[19] QMC, Annual Reports For 1920-1930, passim.

[20] There was a series of about fifty letters between Todd and Lawton in January-April 1920 considering these options.

[21] QMC, Annual Report For 1923, p. 12.

[22] QMC, Directors' Minutes, Directors' Meeting of 19 March 1924.

[23] QMC, Annual Report For 1922, p. 13; Ibid., For 1923, p. 11; and Ibid., For 1924, pp. 6, 11-12.

[24] QMC, Annual Report For 1927, pp. 12-13.

[25] W.A.O. Paul (For the Directors) to the Stockholders of the Quincy Mining Company, 31 January 1928.

[26] Ibid., 29 October 1928 and QMC, Annual Report For 1928, p. 7.

[27] QMC, Annual Reports For 1927-1929, passim.

[28] QMC, Directors' Minutes, Directors' Meetings of 12 April, 1929, 4 June 1930, 19 February 1931 and 3 June 1931.

[29] W.A.O. Paul to the Stockholders of the Quincy Mining Company, 25 April 1930 and QMC, Annual Report For 1930, p. 9.

[30]Gates, Michigan Copper, p. 205.

[31]W. Parsons Todd to the Stockholders of the Quincy Mining Company, 23 April 1932.

[32]QMC, Directors' Minutes, Directors' Meeting of 23 July 1931.

[33]W. Parson's Todd to the Stockholders of the Quincy Mining Company, 23 April 1932; "Notice of Annual of the Stockholders and of Special Matters For Consideration," 27 April 1932; and QMC, Directors' Minutes, Directors' Meeting of 23 April 1932.

[34]Gates, Michigan Copper, p. 205.

[35]Financial Statements For 1936, attached to a letter from W. Parsons Todd to the Quincy Stockholders, 7 May 1937.

[36]QMC, Annual Report For 1938, passim.

[37]W. Parsons Todd to the Stockholders of the Quincy Mining Company, 30 December 1936.

[38]Ibid., 7 May 1937.

[39]QMC, Annual Report For 1937, passim.

[40]The Company's copper production for the remaining years of operation, not including the output of the Reclamation Plant, was as follows:

1927	2,122 tons	1942	N.A.
1938	4,213	1943	3,272
1939	4,418	1944	3,423
1940	4,491	1945	1,477
1941	4,023		

[41]Gates, Michigan Cooper, pp. 172-179 considers the wartime controls in depth.

[42]QMC, Annual Reports For 1943-1945, passim. Output from the Reclamation plant was:

1943	344 tons
1944	2,791
1945	3,033

[43] QMC, Annual Report For 1945, p. 4.

[44] Ibid.

"Technological Change at the Quincy Mine, c. 1846 -1931"

by

Larry D. Lankton

CHAPTER I

Michigan received its Upper Peninsula from the Federal Government in 1837 as compensation for having lost the Toledo area in a border dispute with Ohio. The Upper Peninsula had no agriculture, no industry, and virtually no settlements. But in the early 1840s Douglass Houghton, Michigan's first State Geologist, published reports that greatly enhanced the Upper Peninusula's value: the wilderness was a land of mineral wealth. Keweenaw copper began to lure speculators, adventuresome prospectors, and men with the capital necessary to establish extractive industries.

The Keweenaw Peninsula, a finger of land some 30 miles wide and 70 miles long, located on the western end of the Upper Peninsula, juts northeastward into Lake Superior. It was no secret that the Keweenaw was one of the few places on earth to contain large amounts of native copper -- that is, virtually pure copper existing naturally in its metallic form. The copper outcropped or protruded from the ground in many places. Open pits scattered across the Keweenaw demonstrated that Indians had once mined the copper extensively. They had separated workable pieces from large masses of the metal and had traded them widely across North America. Exaggerated legends of copper mountains had passed from the Indians to French and English explorers in the 17th and 18th centuries, and from the explorers the tales had passed to the populace. But it took the reports of Douglass Houghton, the pioneering of organizations such as the Pittsburgh & Boston Mining Company (which opened the Cliff Mine in 1845), and the verifiable news of huge masses of copper to set off a rush to the Keweenaw.

Speculators formed mining companies and purchased land, usually on the basis of cursory explorations and the hearsay evidence of nearby finds of copper. The copper companies were high-risk ventures, and in the first years of the boom perhaps more money was passed in purchasing land and mineral rights than in actual mining. The Quincy Mining Company, too, was speculative. Formed in 1846, Quincy purchased Section 26, a square mile of land just north of Portage Lake, about a third of the way up the peninsula. Quincy soon began testing its luck, opening the ground to see if sufficient copper lay below to support a profitable mine. This exploratory phase of the company's history lasted until circa 1858, and for most of these years, Quincy's luck was poor.

The earliest, fully developed mining companies on the Keweenaw, like the Cliff, Minesota (sic.) and Central, were mass mines. They were positioned over faults in the earth where impressive masses of metallic copper had randomly formed in large fissures. It was mass copper -- with individual masses sometimes weighing hundreds of tons -- that fostered the mining boom. There was great appeal to the idea of having a mine where large pieces of pure copper were cut up, hauled out of the ground, and shipped off to a smelter, which simply melted them down and cast them into ingots of more useable form.

Quincy's early explorations for mass copper involved no sophisticated technology or science. If the ancient Indian miners had been able to watch Quincy at work, they could have easily comprehended what was going on. A handful of men visually inspected the property, particularly along the hillside above Portage Lake, seeking outcroppings of copper.[1] When they proceeded further, they wielded a modest complement of tools -- hand drills, sledges, shovels, picks, wheelbarrows, and an occasional keg of black powder. Quincy's few men scraped at the surface. They dug pits around outcroppings and trenches that crisscrossed the property. If they did not strike anything, they moved on. If they found copper, they dug deeper. Some finds were of considerable size, weighing up to 8140 pounds.[2] Quincy even sank some short-lived shafts and drove some adits (tunnels) into the hillside, but it discovered no consistently rich ground that merited full development.

Quincy's lack of success was no isolated case. By the mid-1850s -- despite discoveries made by other companies of masses weighing 300, 600, or even 1000 tons -- mass copper had already lost much of its luster. Glaciers had pushed masses of "float" copper across the landscape, depositing them at random points. Consequently, a copper "boulder" could sit atop rock that proved, at great expense, to be barren. And even at the more promising mass mines the copper found in fissure veins often petered out rapidly. A mine could sink a shaft through a huge mass, only to find nothing on the other side. Of all the mining companies, hundreds of them, formed to exploit mass copper, only a very few were profitable, and the profits usually came after several years of expensive, risky development.

Certainly by the mid-1850s, Quincy realized that it would never succeed as a mass mine. Another form of copper, if sufficiently abundant, would have to sustain the company. Quincy continued to look for mass copper, of course, but it also looked for lodes or veins of rock containing particles of native copper making up only 2 to 4 percent of the whole. The early mass mines had hardly deigned to extract this copper rock, but between 1845 and 1925 amygdaloid and conglomerate copper would provide 97 percent of the 7.5 billion pounds of ingot copper taken from the Keweenaw Peninsula.[3]

The fissure veins of mass copper had led some of the earliest mining companies astray, because the veins were located along lines perpendicular to the lodes of copper rock which the longest-lived and most profitable came to exploit. These mass mines stood off to the side of numerous long lodes of copper rock running beneath the broad ridge or backbone of the Keweenaw. Mass copper existed in these long lodes, too, but the majority of the copper came in one of two other forms, depending on the geological history of a given location. Water had deposited <u>amygdaloid</u> copper in the voids left in lava rock by gas bubbles. <u>Conglomerate</u> copper had been deposited in the interstices in a mixture of sand, pebbles, and stones. Amygdaloid, then, had filled holes in surrounding, more-or-less homogeneous rock; conglomerate had filled the spaces around disparate pieces of sand and stone and had bonded them together.

The lodes of amygdaloid and conglomerate copper were sandwiched in tilted rock beds. Anywhere from five to thirty feet wide near the surface, the lodes ran into the ground at angles or "dips" of 30 to 72 degrees.[4] The various lodes, running alongside each other and separated by bands of barren rock, tended to stretch the length of the Keweenaw, so a number of lodes often traversed a given property. This was true of Quincy in Section 26, but most lodes simply did not carry profitable quantities of copper.[5] Quincy's problem was to discover at least one lode that did.

In the early 1850s Quincy moved in no hurry. Failing to find copper quickly, it continued its search on a very limited budget. Quincy lacked both copper and capital, and one deficiency weakened the other. Inadequate capital hampered exploration, and scarce finds of copper dissuaded investors from sinking more money into the mine.

In 1854, even as its directors were investigating a sale of the company, Quincy finally started to more fully develop what seemed the most promising lode on its property. The "Quincy Lode" ran on a northeasterly line, a little west of the road coming up from Hancock that traversed the mine site. Little is known about the physical characteristics of this lode, but by 1856 Quincy had sunk three shafts there and had extracted precious little copper.[6] In its first eight years following incorporation, Quincy had expended $42,100 and had gotten no return. And apparently, from March 1855 to July 1856, the discouraged and poor company had ceased its mining operations entirely.

If Quincy had had only its namesake lode to work, the company would have failed within a few years. But in 1856 the Pewabic Mine, just north of Quincy, discovered a more promising amygdaloid deposit. Quincy resumed its work on the Quincy Lode and began to explore on the eastern side of the Hancock road, where the Pewabic Lode, if it continued far enough south, would be discovered.

From 1856 to 1858 Quincy worked the two lodes simultaneously. To its three shafts on the old lode, Quincy added four new ones on the Pewabic. It was a contest between the two, and the Pewabic Lode won handily. Quincy abandoned its namesake lode in 1858;[7] it worked the Pewabic continuously until 1931. In its long history, Quincy occasionally explored other lodes on its property, but only the Pewabic proved profitable.

When it moved across the road, Quincy had to find the Pewabic Lode, follow it down, and prepare it for working. To incur less expense, Quincy excavated with "tributors," rather than wage-earning laborers. The tributors were not rewarded with money, but with a percentage of the copper recovered from their excavations. When a test pit was shown to be on top of the lode, the excavation was continued not as a large hole, but as a more constricted shaft. This shaft was not vertical; it hugged close to the inclined lode. On Quincy's property the Pewabic Lode, roughly 12 feet thick near the surface, descended at an angle or dip of fifty-four degrees from the horizontal. The lode was sandwiched between layers of copper-poor trap rock. The rock resting above the lode formed the mine's "hanging wall." The rock beneath was the "foot wall." Generally, Quincy sank its shafts in the footwall, although sometimes they passed through the lode itself.

Quincy's shafts in the 1850s and early 1860s were exploratory and developmental. They were exploratory in the sense that until the mine had operated for some time, they were a chief means of testing the lode, of tracing its route and assuring that it continued going deeper. The shafts were also developmental, because by penetrating new ground they helped prepare it for exploitation. To a far lesser extent, the shafts were productive. They were productive only when copper bearing rock was removed as the shafts progressed.

The shafts offered only limited access to the lode. To open it up along its length, miners drove drifts, horizontal tunnels that led away from the shafts and ran through the copper-bearing rock. On early mine mapes the drifts look very straight and regular, but in fact they turned and twisted, following the lode. Sometimes there was no copper rock to pass through. The Pewabic Lode, as Quincy was quick to learn, was by no means a solid wedge. It was extremely rich in some parts, and equally barren in others. A drift, passing from one shaft toward another, might often pass through poor rock. But it was always the hope that if the working-face of a drift was barren, one more day of drilling and blasting might drive it once again into rich territory.

The drifts initially were ten fathoms (or sixty feet) apart, from one down to the next, measured along the inclined shaft. All the drifts a given distance below the surface constituted a working level of the mine. The first level was 60 feet underground, the second 120 feet, and so on. From the drifts, the lode could be worked in two ways to "stope out" or remove copper rock. Miners doing underhand stoping exploited the lode by passing from one drift down toward the next, removing all the copper rock in their path while bypassing barren ground.[8] Overhand stopers (who were far more common) started from a lower drift and worked up. Unless a block of barren ground was encountered and left behind, the stope or cavity, as high as the lode had been wide, would extend from one drift to another, and it could even go beyond that.

Rock taken in the stopes was either raised to the drift above, or chuted to the drift below. It was transported along a drift to the closest shaft, where it was transported to the surface. To complete this very general outline of the mining methods used by Quincy during its early years, two other underground works should be understood. Stopes and shafts were not the only openings that ran between drifts; they were also connected by winzes or raises.[9] These multipurpose passageways were similar to shafts, but they usually started and stopped underground, and they often ran only from one drift to the next. A winze, connecting say the third and fourth levels of the mine, might be located near the working faces of two drifts. Here, if ladders were installed, men had a convenient path between the two levels. They could also use the winze to transport materials, chuting them down to the lower drift, or hauling them, with a windlass, to the upper one. Primarily, however, the winzes in the Quincy Mine served as air passages. Like other Lake Superior mines, Quincy relied on natural ventilation, on air circulating freely in the underground workspaces. Air would not pass freely into a long, dead-ended drift, locked in stone. Driving a winze from that drift to another allowed the air to flow down the tunnel and circulate. Winzes were a vital part of the mine's development work. No long drift was ready to receive stopers until its air needs had been met.

Drifts ran along the lode; tunnel-like cross-cuts ran perpendicular to it. Cross-cuts connected shafts and drifts or ran between two parallel drifts on the same level, where each drift was following its own portion of the lode, which perhaps had split. While cross-cuts were essential to the underground transportation system, they were also exploratory. If a drift continued to pass through poor ground, then perhaps the miners had lost the lode; perhaps it was running parallel to the drift on the east or west side. To test this possibility, the mining captain could direct miners to cross-cut, to drive a horizontal passage perpendicular to the lode and to established drifts.

Quincy sank its first shaft into the Pewabic Lode in November, 1856; its second and third in October and December, 1857; a fourth in December, 1858; and its fifth and sixth shafts in July and August, 1859.[10] The shaft openings were all in a tight row atop the Pewabic Lode. The row started very near the Quincy-Pewabic boundary and ran toward the southwest (see HAER maps). All six of Quincy's shafts were thus compressed into one small part of the mine property. The shafts were only 200 to 400 feet apart, and they served a length of the Pewabic Lode that by the mid-1870s was served by only two shafts.[11] It seems that sinking "surplus" shafts was a means of exploring the lode and, at the same time, of boosting production. By penetrating the lode at numerous points, Quincy learned more about it, and lessened its chances of missing rich blocks of copper-bearing rock. The six shafts also allowed miners to push more drifts ahead at once. Drifts were constricted places, and each working face allowed room for only two or three men per shift. By being able to drift north and south from six different shafts simultaneously, Quincy could put more men to work in preparing ground for stoping. And prior to 1859, Quincy was an unmechanized operation. Its hoisting capacity was limited by a lack of engines and a reliance on hand-powered windlasses, and perhaps horse-whims. With limited hoisting facilities at each shaft, a multiplication of shafts accommodated a larger hoisting capacity and product.

The best place to start a more detailed discussion of the mine's technology is at the working face of a shaft, drift or stope where contract miners (who had quickly replaced the tributors) drilled and blasted rock. Quincy paid them on the basis of how many cubic fathoms of material they removed. (One cubic fathom equalled 36 cubic feet.) The contracts were of relatively short duration. The two- and three-man teams returned to the same spot underground on each shift until their contract expired and they entered into a new one. The miners' work and movement was superintended by a mining captain, a seasoned miner who had moved up in rank. Quincy had no academically trained mining engineers at this time, and in fact in the 19th century such persons never played a very large role in directing the company's underground work. Quincy preferred the savvy gained by long years of experience to textbook training. Those professing the occupation of "engineer" were usually relegated to surveying and drafting work.

To a great extent the mining captains at Quincy determined the company's fortunes. The role was a managerial one; the captain was responsible for negotiating miners' contracts and their rates. It was also a role heavy with technical responsibilities. The mining captains had to have a "nose" for copper. They had to be able to follow the Pewabic Lode through any twists and turns, and whenever the lode vanished, they had to rediscover it. The captain oversaw development and production work. It was the captain's responsibility to read the mine rock, to determine which rock should be stoped out, and which was too poor to be profitable.

The contract miners working in drifts and stopes were skilled laborers. It was the captain's job to put them to work in a particular area and the miners' job to know how to best exploit it. The miners descended into the ground on ladderways built into the shafts. Once underground, they worked and moved only by the light of tallow candles, affixed to their helmets with small balls of clay or attached to some convenient wall or ledge.[12] Like other consumable supplies, such as powder and fuse, Quincy provided the candles and deducted their cost from the miners' contract payments.

The underground shift lasted 10 hours, and for the miner it was divided into two distinct phases. Most of his time was devoted to drilling the rock by simple and primitive percussion. One miner held the piece of octagonal drill steel, which Quincy blacksmiths had sharpened to a chisel point. If he worked with only one partner, the drill was "single jacked" -- the partner repeatedly struck the drill with a sledge, and between strikes the first man slightly rotated the drill steel. If a team consisted of three men, then the drill was "double jacked" -- two sledges were kept in play.

The drill and hammer men could exchange places. It required more strength than skill to drive the holes, but skill was involved in locating them properly to assure that the subsequent powder charge freed as much rock as possible, and from just the right place. The miners spent seven or eight hours drilling a pattern of only 6 or 8 holes into the rock. The holes were driven at angles that brought them closer together as they penetrated the wall. By angling the holes, the miners better directed the force of the explosion. If later practices can be extrapolated back to cover the actions of Quincy's earliest miners, when the end of the shift was an hour or two away, the miners stopped drilling and charged all or a portion of the holes, using black powder exclusively. The miners cleared the holes of chips, tamped the powder in, and applied wad and fuse. After clearing the area of all tools, they lighted the fuse and retreated to safety. It was common for the miners to retreat in different directions, so they could stop others from unknowingly entering the blast area.

The miners varied their fuse lengths. They timed the powder charges to fire individually, not all at once, both as a precautionary measure and to increase their effectiveness. From the safety of their cover, the miners counted the rapid succession of explosions. If eight holes had been charged, and eight explosions were heard, then the miners' work for the shift was completed. A drift, cross-cut or shaft had been driven several more feet, or copper rock in a stope had been freed. But if too few explosions were heard, then the miner had to check to see if any explosions had overlapped, or if indeed their had been a "missed hole," once that failed to go off. After waiting judiciously for any belated detonation, and for noxious gases to clear, the miner went back to investigate. Any missed hole had to be detonated then and there, or at least mentioned to the mining captain, to assure that it was dealt with. A missed hole, if undetected, was an accident waiting to happen. If any unknowing person lated drilled into it, the mine had a fatal accident, and the cause of death would be graphically listed in a single word: "blasted."

Miners generally exploded their charges at the end of a shift, because the fumes and gases that they created were unpleasant at best, and deadly at worst. Quincy miners occasionally died of suffocation when they returned too early to the scene of a recent blast. After the blasts had occurred, the miners climbed ladders back to the surface. They walked to the change or dry house, cleaned up, changed back into their street clothes, and hung their sweaty work clothes to dry. About two hours later, the next shift of underground men moved through the dry in the opposite direction on their way to work. During those two hours the natural ventilation in the mine worked to clear the air. Air entered the mine through those shafts that were down-draft. It passed through the drifts, stopes, cross-cuts and winzes, and exited through up-cast shafts. Some stopes and drifts no doubt received less air exchange than others and remained close. Nevertheless, Quincy, like the other Lake Superior mines, maintained a high air quality, and ventilation would not prove a major problem for nearly half a century.

Not all underground workers were miners. Others had equally or more arduous tasks, such as breaking large pieces of rock that had been blasted, removing rock from the blast area ("mucking" it out), and transporting rock to the shafts where it could be raised to the surface. These laborers needed strong backs, but their work required little skill or experience. Because the miners were the experts, when they went to their work locations they were responsible for inspecting them to assure not only their safety, but the safety of others working nearby. The omnipresent danger was loose or unstable rock falling from the hanging wall. If they followed proper procedure, upon entering any work area the miners first tested the roof. Candles provided very limited illumination, so a visual inspection alone was unsatisfactory. With an iron bar, perhaps with the end of a handy drill, the miners struck along the hanging wall. Sound was the key. If a crisp ring was returned, the hanging was presumed safe. But if a false note was heard, the wall demanded further inspection. Any loose or questionable area was barred down or braced by a timber stull or post. Only after such inspection and corrective action did the men proceed with work.

Getting broken rock to the shaft was labor intensive. The method of moving the rock depended on whether it was taken from over- or under-hand stopes. Overhand stopers started at or near a shaft, and as they advanced they carried the stope out along one drift and up towards the next. At the uppermost levels the sharp dip of the Pewabic Lode was nominally 54 degrees, but in places the lode curved up to run almost vertical. Overhand stopers used this dip to advantage. As explosions were set off, loosened rock fell on the steep incline and rolled down to the bottom of the stope, where timbermen had built a barrier to check its descent, to keep it from blocking the drift. Men passed the rock through chutes or openings in the timber wall and loaded it into tramcars, or in less developed drifts, perhaps into wheelbarrows.

In its early period, much moreso than later, Quincy also used underhand stopes, which progressed from one level down to the next. With this arrangement, gravity was a liability, rather than an asset. To remove the rock, Quincy contracted laborers to load it into wrought-iron buckets or "kibbles," connected by a chain or manila rope to hand-powered windlasses. Once hauled up to the drift, the rock was transported horizontally to the shaft.

Underhand stopes required more labor, but they were advisable under certain conditions. Any rich block of ground, say between the third and fourth levels of the mine, could be exploited more rapidly if attacked from above, as well as from below. And an underhand stope could save the cost of removing worthless poor rock. For example, assume that 50 feet north of the No. 4 shaft the drift on the third level passes through rich rock, while the fourth level below is in poor territory. By moving up from the fourth level, stopers would have to remove an unknown quantity of poor rock before hitting the copper pocket. But by moving down from the third level, stopers would be in the copper-rock from the start and could stop as soon as they had exhausted it.

The contract miners, whose pay was determined by the cubic fathoms they removed, exploited the lode thoroughly. If the rock had copper in it, they took the rock out. The miners did not use the "pillar and stope" method. In rich ground, where the shafts passed through the lode, they left no large stone pillars beside the shafts to protect them. In large stopes they left no regularly spaced pillars to support the hanging wall. Only poor rock stayed behind. In some large lode pockets there was no poor rock, so the pockets became large unpillared cavities, some 12 to 18 feet wide, that could extend more than a hundred feet up and across the mine.

There were good reasons, at least at the time, for not using stone pillars, and for using relatively few timber supports. The company struggled for some fourteen years before paying dividends. Shortly after it began to produce commercial quantities of copper, the Civil War caused copper prices to rise, and this encouraged higher production. The mine lost money if it left copper in the ground to help hold up the hanging wall; it made money if it pulled it out. Also, the company simply had no idea of how long it was going to live with this mine. It did not know how deeply the Pewabic Lode ran, and whether Quincy would survive ten, fifteen, twenty, or thirty years while mining it. So they took the copper out where they found it, not knowing how much more existed below. Finally, there was a pragmatic reason for sustaining this practice. Quincy left no pillars and timbered sparingly, and yet the hard-rock hanging wall stayed put. There were no catastrophic rock falls, only occasional localized falls that no pillars could have prevented, unless by chance they had been left just below the faulty rock. If Quincy first left no pillars in order to maximize profits, it continued to do so because it worked. A critic in the 1870s would fault the wisdom of neglecting to systematically support the hanging wall, noting that, "The solidity of the ground is remarkable, but it must one day give way."[13] That day would indeed come, but not until after 1900.

In the 1850s and 1860s, men with "wheeling" contracts pushed rock from the stopes to the shafts for hoisting.[14] They were paid on the basis of how much rock they moved.[15] (Wage-earning trammers later replaced the wheeling contractors, but they performed exactly the same function.) Wheelbarrows may have been used briefly underground, but by 1862 Quincy's drifts and cross-cuts were equipped with a total of eleven tons of light-weight, narrow gauge iron rails.[16] Teams of two or three men loaded four-wheeled tram cars by hand and pushed them along the rails to the nearest shaft. A few Lake Superior mines used draft animals underground for tramming or haulage, but Quincy never did. It did, of course, use draught animals -- horses and oxen -- on the surface.[17]

Before tracing the travel of mine rock any further, it is important to remember that amygdaloid rock with its small percentage of copper was not the only product of the mine. Quincy also took considerable mass and barrel copper. Barrel copper, from fist-sized pieces of native copper up to those weighing some 50 pounds, posed no problems underground. Often bound by clinging rock, barrel copper was treated like other mine rock in the manner in which it was removed and transported to the shafts. But mass copper -- with a single find being perhaps the size of a small room --was another matter entirely. Large masses were very difficult to dislodge from the surrounding rock, and then too big to pass readily through the drifts and too heavy to hoist. And once on the surface they would have been too big for smelters to handle. So each underground treasure had to be reduced to a number of smaller pieces, and the gummy, malleable nature of copper made this task difficult.

It was a problem just to free a large mass from adjacent rock. It had an irregular form, jagged edges, and appendages that ran hither and yon into rock. To expose it, miners had to drill and blast their way over, under, and around the mass. When a cavity of some size had been started in behind it, then black powder was again resorted to. But this time the charge was not measured in ounces or pounds, but in kegs. Miners tucked full kegs of powder between the mass and the mine wall, and laid sand bags to contain the blast and direct its force. With enough prior work and powder, the explosion freed the mass. Because of the abnormal amount of powder used, and the resultant increase in noxious gases, this work was sometimes done on Saturdays, so the natural ventilation could work all day Sunday to clear the mine's air.[18]

Some metals are brittle and can be fractured with impacts; some are easily cut with toothed tools. Mass copper was neither. Kegs of powder could not break it; nor could miners armed with sledges or picks. Miners could not saw it, and there was no machine to help with handling mass copper. They resorted to hand-held chisels and sledges. One or more teams -- each composed of two strikers and a chisel-man -- cut up the mass just one blow, one nick at a time, until it was reduced to pieces small enough to be hauled, hoisted and smelted. Because it called for such special handling, mass copper was not treated like ordinary rock in the awarding of contracts by the mining captain. Quincy may have used wage-earning miners to handle its masses, instead of contractors; or if it used contractors, they were not paid on the basis of cubic fathoms, but on the basis of how many feet they chiseled their way through. Regardless, the task was laborious. At the Minesota Mine it took one and a half years to cut up a 500-ton mass, and at Quincy and other Lake Superior mines it typically took three men about three to four months to cut up an "ordinary" mass of 50 to 60 tons. Consequently, it cost the company as much or more to pull up mass copper as to mine and treat amygdaloid stamp rock yielding the same amount of the metal.[19]

When wheeling contractors brought rock or mass copper to the plats or stations where the drifts or cross-cuts intersected the shafts, the material was ready to be hoisted. At this point, the technology became more complicated, because it involved more men, buildings and equipment -- some above ground and some below.

When Quincy sank its earliest shafts into the Pewabic Lode, men with hoisting contracts raised the rock, apparently with hand-powered windlasses mounted right at or over the shaft collars.[20] The windlasses wound or unwound chain or heavy manila rope and pulled rock to the surface in kibbles, one per shaft. The kibbles moved in their own shaft compartments, separated from the ladderway by a timber wall. The wrought-iron kibbles weighed approximately 600 pounds empty and had an estimated capacity of 1,000 pounds.[21] To handle large mass copper, shaft workers removed the kibble from the hoisting rope or chain and connected a heavy manila rope that had been wrapped around the mass, forming a kind of web.

From the late 1840s to the early 1860s, some Lake Superior mines used horse-whims; horses harnessed to booms, by walking in a circle, rotated a winding drum. Quincy, it seems, never made a complete transition from hand-windlasses to horse-whims, before it switched to steam-powered hoists. The only two reliable mentions of a horse-whim on the Quincy property -- dated 1859 and 1861 -- list only one whim, which by the latter date was no longer in use.[22] A few after it started working the Pewabic Lode, Quincy moved rather directly from hand-power to steam, largely skipping over the horse-powered stage. Quincy began mechanizing its hoists by at least the end of 1858; in November and December it contracted for a well to be sunk near an unspecified "Engine House."[23] By March 1859, a Quincy inventory listed two hoist houses and two "portable" hoisting engines.[24] In all likelihood, these early houses and engines were transitory. More permanent structures and equipment were erected later in 1859 and 1860.

In May 1859 Quincy purchased a portable hoisting engine from George M. Bird & Co., "Machinists, Manufacturers of Stationary, Portable, Pile Driving & Hoisting Steam Engines," of East Boston, Massachusetts.[25] In June and July, 1859, Quincy registered expenses for moving the engine to the mine; boarding the Bird engineers who helped install it; laying 172 perch of stone at a hoist house between Shafts 1 and 2 (which it called the No. 2 Hoist House); and for sinking a sump there.[26] Several months later, on Nov. 16, 1859, Quincy signed Articles of Agreement with the J.B. Wayne & Co. of Detroit for a new high-pressure, horizontal engine that had a 24-$^5/_8$ inch bore, 5-foot stroke, 13-foot flywheel, and a link motion for reversing and cut-off.[27] By August 1860, Quincy was constructing a No. 4 Hoist House for this engine, which was located between Shafts 3 and 4.[28]

The hoist houses were located between the shafts, so the engines could be made to hoist from more than one. By the end of 1860, or shortly thereafter, the Byrd engine hoisted from shafts 1 and 2, and the J. B. Wayne & Co. engine pulled from shafts 3,4 and 5.[29] By mid-1861 Quincy replaced the horse-whim at Shaft No. 6 with a "small engine," perhaps one of its old portables, or a used winding engine which Quincy had acquired from the Hancock Mining Co. in October, 1860.[30] On the surface the switch to steam-powered hoists was complete, but windlasses were still used underground. They hoisted rock from one level to the next, and sometimes from the very bottom of the mine up to the lowest level that could be reached by the early, smallish steam hoists.[31]

In February, 1861 the No. 2 Hoist House burned to the ground. The portable Bird engine reputedly escaped serious injury and was put back in service. But the Mine Agent, S.S. Robinson, noted a few months after the fire that the engine, hoisting then from the fourth level (about 240 feet) did not seem powerful enough to hoist from much deeper.[32] So in 1862 Quincy built a new No. 2 Hoist House around a different engine -- a "double" (two cylinder) Bird engine, acquired second-hand from the Pontiac Mine. The new installation cost $5,242.[33]

By 1862, Quincy had used at least six different hoisting engines, only two or three of which operated at any one time. This turn-over suggests that Quincy was very cautious and frugal in its equipment purchases. Three of the engines were smallish "portables"; two were second-hand; and several rather quickly reached their hoisting capacities, which caused the purchase of yet other engines. To summarize, when it first went to steam hoists Quincy often looked to short-term, rather than long-term, benefits. It did not go consistently or immediately to large, expensive hoists which could remain in place for ten or twenty years before becoming inadequate. The J. B. Wayne engine at No. 4 was the first exception to this rule; it saw service from 1860 to 1872.

Hoist houses, taken with their equipment, were the most expensive structures built at the mine in the late 1850s and early 1860s, so it is not surprising that Quincy economized in their construction. The hoist houses, of all the mine's structures, were perhaps most susceptible to fire because of their boilers, yet Quincy built them of wood. And by 1862, it had three hoists operating six shafts, instead of having one engine per shaft. This arrangement saved considerable expense in capital equipment. It also meant that the company had to employ fewer engineers, boilermen, and mechanics. It also saved fuel costs, because only three, not six, boilers had to be kept fired.

The engines, at least those at No. 2 and No. 4, were not direct-acting; their winding drums were not mounted on extended crankshafts. Power was transmitted to the drum through the intermediary of a friction gear.[34] The engine directly powered and turned one set of wheels; the hoist engineer controlled the movement of a second set connected to the drum. By bringing the second set into contact with the first, the engineer set the drum in motion and wound the hoisting chain. The hoisting chain, from the winding drum to the shafts, passed over pulleys supported on wooden, trestle-like affairs. A pulley or sheave mounted at the proper angle atop a heavily-timbered shaft-house allowed the chain to bend around and head directly down the shaft.

The hoists, pulley stands, and shaft-houses were so aligned that an engine could lift rock from one, two, or even three shafts, but apparently from only one shaft at a time. Only one chain operated off a drum, meaning that hoisting at shafts 1 through 5 was an intermittent operation. (The No. 6 shaft had its own small, unshared engine.) The notion is reinforced by the fact that in December, 1861, when six shafts and only three engines were in operation, Quincy employed three men -- not six -- as "landers" to receive hoisted rock in the shaft houses.[35]

The steam hoists, like the windlasses, hauled rock in kibbles, but the buckets were larger. They weighed 1000 to 1400 pounds and carried about one ton of rock. The kibbles were filled at one of several lower levels in the mine; they were dumped at the shaft-house; and all the while the kibble's motion was controlled by the hoist, located in its separate structure, 150 to 300 feet from the shaft. The smoothness of the operation depended on the ability of three men -- the "filler" underground, the "lander" in the shaft-house, and the "engineer" in the hoist house -- men who could not see or speak to one another -- to communicate via pull-ropes and bells.[36]

When rock arrived at an underground hoisting station or plat, the filler, by pulling his bell rope, signalled the lander in the shaft-house. The lander, similarly, by ringing the right number of bells, signalled the hoist engineer to send the kibble to the proper level. (Even on the earliest steam hoists, the engineer probably had a "miniature," a clock-face kind of dial whose hand moved in relation to the rotation of the hoisting drum, and thus indicated the position of the kibble.) The filler rang the kibbles arrival at the desired location, and rock was dumped directly into the bucket. Then the filler rang to have the kibble hoisted. The iron bucket, not moving on any tracks or guides, but presumably skidded over heavy planking laid down the shaft, banged and clanged its way to the surface. As it neared the shaft collar, the hoist engineer slowed its ascent, and upon a signal from the lander in the shaft-house, he stopped it.

The earliest Quincy shaft-houses were simple affairs. They were of a design common to the region and one possibly derived from Cornish precedents. The sides of the board-and-batten shaft-houses carried a slight batter or slope, so the structures were broadest at the base.[37] A shaft-house contained little equipment, save for the sheave and possibly a winch of some kind to tip and thus dump the kibbles.[38] The kibble was probably drawn part way up the shaft-house on an incline before it was dumped, so the rock could slide down another incline into small cars, which transported it to a sorting house.[39]

In most cases, the sorting house was attached to the shaft-house.[40] Here laborers picked over the material by hand and sorted it by kind and size. On sight alone they rejected "poor" or "waste" rock. It may have contained some copper, but the sorters deemed the amount insufficient to merit further processing, so they relegated it to the burrows or waste-rock piles located east of the shafts. They examined mass copper to see how much rock adhered to it. Sufficiently clean mass could be transported to a copper house, where it was simply stored while awaiting shipment to a smelter. The remainder of the mass was sent to a kiln-house for treatment. Quincy cleaned mass copper of adhering rock because later it would pay a smelting fee based on the gross tonnage put into a furnace, rather than on the net tonnage of copper that was extracted.

Amygdaloid "stamp rock" comprised by far the greatest tonnage that arrived at the sorting house. Some 97 to 98 percent of the stamp rock was waste -- the lava rock surrounding the cavities which had filled with copper. Unlike mass copper, stamp rock could not be smelted directly. It had to go through various crushing, washing and sorting operations at Quincy's stamp mill on Portage Lake until it was transformed into "mineral," which was some 80 percent copper and could be smelted.

The gravity stamps at the mill could accept rock no larger, it is believed, than about 3 to 6 inches in diameter. Because stamp rock arrived at the sorting house in large and small pieces (anything that would fit in a kibble), it had to be sorted by size. Men wheeled small enough rock directly to the stamp-mill tramroad on the southern end of the mine location. They wheeled larger rock a short distance to one of three or four kiln-houses for calcining and size reduction.[41]

At each kiln-house in the early 1860s, ten to twenty-five men worked under contracts to "Burn and Dress Copper."[42] They built a heavy bed of timbers, covered it with stamp rock and mass copper, and then set the timbers on fire. The process was best described by O. W. Robinson, who worked at Quincy kiln-houses in the early 1860s:

> After the rock was brought to the surface it was calcined and broken up by hand. At the mouth of each shaft was a long shed with open sides called a kiln house. In this, first was built a foundation of wood twenty-four feet square and four feet high, with arches or openings in which to start the fire. Around and over this pile of wood, mine rock was heaped to the height of four or six feet more, and then the wood set afire. The heat cracked the rock and made it much more easily broken, which was done by hand.

> These kiln houses were large enough to allow the building of three kilns in each one, so that while one was being burned out another would be in process of construction, and the men might be breaking up rock on the third.[43]

Other descriptions of Lake Superior kiln-houses mention that men used water to break the rock, by pouring it on the pile as the fire died down. The water caused the rock to cool more rapidly, contract, and crack. Quincy may have used this technique.

After a burn, kiln-house workers sorted the rock again. Large mass went to the copper house, as did the smaller pieces of mass that were liberated and discovered during calcining. (These pieces were put in barrels, hence the name "barrel work" or "barrel copper.") Wheeling contractors pushed the stamp rock over tracks in cars to the head of the stamp-mill incline.[44] The 3,500-foot-long incline was double-tracked.[45] The rock descended in a car connected to a rope that unwound from a drum. As the loaded car (or cars) went down, the drum wound a second rope that pulled an empty car back up the incline.[46] In 26 1/2 working days in April, 1861, 2065 cars travelled from the mine to the mill.[47]

Between 1858 and 1862, Quincy evolved from a speculative mine to an established concern. Through mid-1856, the company had expended just $42,100. This figure included all real estate purchases and the costs of exploring and working the Quincy Lode. Then Quincy continued to work its namesake lode while simultaneously exploring the Pewabic. In two years of increased activity, from May 1856 to March 1858, the company spent an additional $60,600.

Quincy then abandoned its original works and concentrated on the Pewabic, and notably increased its expenditures and the scope of its operation. Between March 1, 1858 and March 1, 1859, all company expenses amounted to $123,100. The mining account alone totalled $100,395, and yet the expenditure for machinery was a paltry $780. During the year ending March 1, 1860, Quincy's costs of business nearly doubled to $220,000; the company, as evidenced by an Annual Report, charged $166,200 to its mining account, and approximately $20,000 to machinery. Over the next twelve months, the figures again increased substantially. Quincy expended $314,000, with $231,000 charged to mining and $24,500 charged to the machinery account. Clearly, by 1861-1862, Quincy had finally passed from an exploratory era into a productive one.

Figures for copper production prove the same point. Prior to 1856 Quincy sold almost no copper. The 590 pounds shipped in 1854 included the weight of the barrel! In 1856 it sold 13,462 pounds, and in the next year, 122,762 pounds. In 1858, Quincy's mineral, including barrel and mass copper, yielded 306,800 pounds of ingot; in 1859, 357,000 pounds. In 1860, 1861 and 1862 copper production jumped to 1.1, 1.5 and then 2.2 million pounds of ingot. Production rose throughout the Civil War, and Quincy's Annual Report for 1865 boasted a production of 2.7 million pounds for that year.

In making itself profitable between 1858 and 1862, Quincy had remade the environment. Without doubt, Quincy Hill above Hancock was scarred. Trees had been cut for use as fuel or building materials. The landscape was pocked with the evidence of explorations, and burrows of grey waste rock had begun to rise, changing the natural terrain.

And Quincy's early buildings were no esthetic embellishments. They were utilitarian structures, most of wood, a few of stone. They were merely solid and serviceable.

By 1862, a shaft house, 35 to 40 feet tall, stood over each of the six shafts and their timber-cribbed collars. Along the row of shaft houses Quincy had erected four sorting houses and three hoist houses, timber-framed buildings that stood on poor-rock foundations. On one side of each hoist-house a tall wrought-iron chimney stood atop a masonry base, and on another stretched long rows of cordwood, taken in 1862 and thereafter, from Quincy's own woodlots, that were consumed as fuel. Within each hoist-house were four major components: one or more boilers, an engine, a friction driving gear, and a winding drum. A little east of all these structures stood four kiln houses. The hoist and shaft-houses were connected by pulley stands that supported the hoisting chains; narrow-gauge tramways interconnected all the shaft, sorting, and kiln houses; and a tramway running past all the sorting and kiln houses terminated at the drum house on the southwestern end of the mine which served the stamp-mill incline.

In addition to these major structures and facilities, by 1862 Quincy had its copper house for storing barrel and mass, a stone magazine for black powder, and a general-purpose warehouse. It had one change or dry house, two small blacksmith shops, plus a carpenter shop with a small steam engine for driving bench saws and a lathe. The road leading from the village of Hancock up to Quincy Hill neatly divided the mine location into halves. Excepting the blacksmith and carpenter shops, all the technological mine structures stood on the east side of the road. On the west side stood the company office, a store, a barn and root-house, a forty-bed hospital, and numerous company-built houses.

Quincy by no means stood pat during the rest of the 1860s. It significantly changed and improved its physical plant and altered some of its technologies. Many changes were associated with the problems of moving men, rock, and water out of the mine.

Between 1861 and 1864 Quincy gradually replaced its hoisting chains with wire rope, a product which remained in use until the mine closed. A hoisting chair or rope was by no means a permanent fixture. Each had to be replaced periodically, perhaps once a year. Quincy bought its hoisting chain in long lengths, sold by weight. In each of the years 1860, 1861, 1863 and 1864, Quincy purchased at least 1,000 feet of chain, and in 1862 it bought 3,200 feet of three-quarter-inch chain forged of Lake Superior iron from the Wyandotte Rolling Mill Company.[48]

The 1864 purchase of hoisting chain was the last of its kind.[49] By 1861, Quincy used 1,200 feet of wire rope with its No. 2 hoist,[50] and it purchased additional "No. 5" Roebling ropes in 1862 to 1864. Before Civil War inflation drove prices up, Quincy typically paid 9 cents per pound for three-quarter-inch chain, or 51 to 60 cents per foot. The company purchased its first round wire ropes at the higher prices of 61.6 to 64.2 cents per foot. Clearly, initial cost was no incentive to change.

Wire rope may have been somewhat longer-lived or safer than chain, but its biggest advantage lay in its lesser weight. In an 1861 letter to Thomas Mason, S.S. Robinson complained of the heaviness of chain and suggested that wire rope could save two-thirds the weight.[51]

This savings was not quite realized. Quincy's chain weighed 5.7 to 6.6 pounds per foot; its No. 5 wire rope, 3.6 to 3.8 pounds. Nevertheless, the savings was important. When the engines hoisted, they expended energy not only in raising the rock carrier and its contents, but also in raising the hoisting rope or chain itself. Wire rope significantly reduced the loads on Quincy's engines. At the least, this reduction allowed for the consumption of less fuel and steam. It also extended the useful life of an engine as the mine got deeper. An engine with power sufficient to raise a loaded kibble and just 500 feet of chain could reach deeper when lifting with lighter rope.

Quincy changed its hoisting technology in another way in 1863; it began replacing its kibbles with "skips." Several other mines in the region introduced these box-like rock carriers at about the same time.[52] Fabricated of half-inch wrought iron plates and angle-iron, and measuring some five feet long and 44 inches square, the first skips carried a bigger load than the kibbles and travelled faster.[53] The skips ran on four 12-inch wheels and traversed an iron-clad "car road" that Quincy timbermen had laid down the shafts.[54] Because they were tracked, the skips could be hoisted and lowered faster; they did not suffer the abrasion that wore away at kibbles; and they inflicted no damage to the shaft and its timbering.[55]

Quincy ordered its first three skips in June, 1863 from J & J Brennan in Detroit and received them by September.[56] It was no small task to lay the requisite car roads down into the mine. This work was difficult to stage and execute, because it interfered with normal hoisting operations. Quincy could not lay all its car roads at once, for this would have stopped all hoisting at the mine, shutting it down. By the end of 1864, however, timbermen had tracked three shafts (presumably the most productive ones, Nos. 2,3 and 4), and Quincy probably stopped at that.[57] There is no evidence that the other shafts were ever tracked before they were closed. At any rate, the skips, once they arrived, stayed for good. Later, the single skip track in a shaft would be joined by a second, and the skips would increase substantially in size. But the basic shape of the rockskip remained unchanged through 1931. (See HAER drawing).

In 1867 Quincy expended $8,760 to install a "new" hoist house, engine and boilers at No. 2. The engine was actually second-hand. Quincy traded one of its Bird engines and a portion of a friction gear to the Hecla Mining Company, ten miles to the north. In return, Quincy received a Hodge & Christie upright engine. Although configured differently that the horizontal J. B. Wayne engine at the No. 4 shaft, the Hodge & Chrisie was virtually the same size, having a bore of 26 inches and a 36-inch stroke. For the first time, Quincy had large engines at both main hoisting plants — at No. 2 and No. 4. These engines provided longer-term hoisting capabilities. The rapid turnover of hoisting engines had come to an end.

In 1866 Quincy mechanized another important part of its underground transportation system: the raising and lowering of men. The mine shafts had reached depths of 600 to 725 feet. When the lower levels were accessible only by ladders, the workers faced a long and difficult climb, and the company lost productivity during the time the men were getting to and from their work stations.[58] To benefit both the company and its men, Quincy installed a man-engine. This mechanical, moving ladder operated in its own shaft, located between shafts 3 and 4. While details of the design and construction of the man-engine are lacking, aside from the fact that it was designed and built by Quincy employees, the general principles of its operation are clear.[59]

The man-engine consisted of two side-by-side wooden beams or rod that rested on rollers and ran down the inclined shaft. The beams carried small horizontal platforms or steps mounted some ten feet apart. The upper end of each beam was connected to a triangular bob at the surface that was rocked on a pivot by a rotating steam engine. The mechanical connections were such that while one rod was going down, the other was coming up. Then there was a short pause or stop before the beams reversed direction.

To ride the man-engine to work, a miner stepped on the top platform of the rod which had just come up. In its next motion, the rod moved down ten feet and stopped. While the machinery was at rest temporarily, the miner stepped over to the platform on the adjacent rod. The second rod then moved ten feet down and stopped, and the miner crossed back to the first one. After riding it down, he again stepped over, and so on. The miners, one to a platform, went down into the mine ten feet at a time by always stepping over to the rod which was poised to descend. At the end of a shift, they reversed the procedure and reached the surface by stepping over to the rod ready to go up.

Cornish mines had developed the man-engine in the early 1840s. The Cliff Mine introduced this technology to the Lake Superior region early in 1865, and later that year the Pewabic followed suit. So Quincy, with its 1866 man-engine, was not far behind. Surely the mine's competiveness in the area's short labor market would have been impaired, had it not offered this amenity.

Quincy's man-engine cost $17,500, and for many years the company expended funds annually to repair it and to lengthen the man-engine rods so they reached the deepest levels of the mine.[60] The man-engine did not operate continuously, but only at the beginning and end of each shift, when the largest number of men had to be transported. This cessation meant that once the men were in the mine, most of them had to stay down for a full ten hours. They took their meals underground, unless they wanted to scramble up one of the shaft ladders (which were still maintained for safety reasons and to facilitate travel between levels), or unless they rode to the surface in a rockskip, and risked injury by doing so. It also meant that the steam engine powering the man-engine was not tied up all day; it could be used for something else. In Quincy's case, the engine also powered a pump which unwatered the mine.

Like most mines in the copper district, Quincy was relatively dry. Nevertheless, whatever surface water had seeped into the mine had to be removed. Quincy had three basic means of unwatering its mine, and they were not mutually exclusive. Over time, Quincy used all three means, sometimes in combination. The company could bail water, collecting it in underground sumps and hoisting it out of the mine in buckets or skips, much like it hoisted rock. Because it was on a hill top, Quincy could use gravity and "launders" (troughs) to unwater its upper levels. Water moving down the mine could be captured and channeled into a launder graded on a downward slope. This launder, by maintaining its slope as it passed across a level and then through an adit or tunnel, carried the water out of the mine, depositing it on the hillside between the mine and Hancock. Lastly, Quincy could pump water up and out of the mine through pipes.

In its first years of exploiting the Pewabic Lode, Quincy bailed water; men entered early contracts "to Hoist Rock and Water."[61] The hoisted water probably served Quincy's boilers after being held in cisterns where impurities settled out.[62] Between 1860 and 1862 the mine bought a number of pumps and built a pumphouse, but these seem not to have been used for unwatering the mine.[63] They may have been installed at the stamp mill, to pump the water from Portage Lake needed for milling operations, or they may have been used to feed water to the mine's boilers. The first mine pump known to have been used for unwatering was purchased and installed in 1863 -1864. Quincy purchased the pumping engine from Wayne and Robinson for $1550, and purchased $1940 worth of accoutrements (pipe and so forth) from the Detroit Locomotive Works.[64] In 1864 Quincy expended $1062 to install the equipment in its No. 4 shaft. The engine itself was mounted on the surface, and it rocked a bob that reciprocated a pump rod running into the mine. The pump drew water that had been carried in launders to several sumps located right next to the No. 4 shaft.

Quincy's six shafts and their attendant drifts quickly made it clear that the Pewabic Lode was extremely "bunchy" or "pockety." Where copper existed, it was rich, but there were barren zones in the mine, and some of the shafts were sunk in far better ground than others.[65] Miners found little copper, for example, north of the No. 1 shaft, moving towards Quincy's boundary with the Pewabic Mine. Similarly, the southern ground of the No. 5 and 6 shafts (and of an abortive No. 7) proved disappointing. Copper was drawn most consistently from shafts 2,3 and 4.

The Pewabic Lode was capricious in another sense, besides its bunchiness. In 1867 and 1868 Quincy went through considerable trauma when copper pockets proved scarce; some feared that the lode was already petering out.[66] Either that, or the lode had been lost.

The latter proved true. In this instance, the lode had split in two parts, separated by a huge "horse" or wedge of trap rock that resided where Quincy thought the main lode should have been.[67] Efforts normally airmed at production were re-aimed at exploration — where was the copper? Cross-cuts finally located the aberrant lode, and production again picked up. In the course of this scare, Quincy learned a hard fact about the Pewabic Lode that it would have to contend with for nearly seventy years. There was no one lode, but a series of branch lodes of copper bearing rock, separated by trap. There was indeed a main branch -- the one that Quincy's shafts were following into the ground -- but there were layers of amygdaloid lying to the west and the east. At any given depth, the copper rock could be disappointing in one branch and rich in the next one over. In short, the copper was not concentrated in one plane, but was dispersed in a number of planes. Consequently, Quincy had to be more vigilant than most mines in seeking its copper rock, and on some levels it needed several drifts, connected by cross-cuts, to fully exploit the lode's "tortuous windings." The local agents or superintendents occasionally noted that Quincy's lode was the most difficult to follow in the Lake Superior region.

In the 1860s Quincy continued to explore. It mined only the Pewabic Lode, and its works occupied only a small fraction of its total land holdings. So Quincy continued to look for other workable lodes. At the same time, the works on the Pewabic Lode contracted. Several of the original shafts, opened in 1856-1859, closed.

They closed by fits and starts. Hoisting would stope for several months, then resume briefly, then stop again. Finally the shutdowns became more extended, until some shafts clearly were no longer productive. Still, some of the shafts were, for a while, carried deeper. Miners drove them down to help press development work, or they carried them down as winzes to aid in ventilating the mine.[68]

In the early 1860s Quincy had six and then seven shafts in a line. Those on the ends proved most expendable. Quincy closed the No. 1 shaft by December 1867. After that, for many years it served only as a winze. The ground first penetrated by this shaft, when deemed rich enough, was thereafter mined from drifts driven northward from the No. 2 shaft. Shaft No. 3 lasted throughout the 1860s, but by 1871-1872, after it had reached the seventy fathom level (420 feet), it was continued only as a winze. Rock from this part of the mine could be hoisted through No. 2, some 300 feet to the north, or through No. 4, 260 feet to the south. Shaft No. 5 petered out between July 1865 and January 1867; No. 6 closed in 1864; and No. 7 -- a very short-lived shaft that seemingly was never served by a permanent steam hoist, closed between July 1865 and January 1867.[69]

Without question, the failures of the southernmost shafts — 5,6, and 7 -- were severe setbacks for Quincy. An Annual Report noted that, "Taken as a whole the mine looks well, if we except the south end. . . ."[70] The company halted the southern shafts because in this part of its property the ground was faulted and the Pewabic Lode seemed to disappear. In 1861, with high hopes, Quincy had erected a steam hoist at No. 6.[71] Just three years later, the No. 6 engine consumed very little cordwood, and even that was not used for hoisting. The ground had proved so poor that Quincy had rigged the engine to saw wood and grind grain.[72]

Quincy did not give up easily on its southern ground, or that area known as the "side-hill," between the mine and Hancock, where the tramroad ran on its way to the stamp mill. In 1864, as its established southern shafts were failing, the mine began exploring this ground extensively by driving a tunnel or adit through it.[73] This expensive work started during the boom years of the Civil War and continued throughout the bust years of 1866 to 1868, when the copper market was depressed and many Lake Superior mines struggled to survive. The fact that Quincy continued its exploration after the war signified the great importance which the company placed on this work. Quincy first anounced the "side-hill adit" in its 1864 Annual Report:

> Besides the Pewabic vein. . . , many other veins are known to exist upon the Company's property, and your Directors have long been desirous of ascertaining their value. To this end, a system of explorations was organized early in the summer, and, after a number of surface openings, it was decided to drive an adit across the formation, which would cut and thoroughly prove all the lodes, and be available to work economically any that should prove to be productive. This adit is now in progress, and promises the most satisfactory results.[74]

The earliest exploration contracts were for open excavations — trenches or pits. If the open excavations were at all promising, the company contracted miners to open drifts or cross-cut leading from them. By October 1864 the company was contracting miners to drive a long adit into the hill, and by October and November other miners were sinking two shafts to intersect the adit's line. Once the shafts reached the level of the adit, the miners could work that tunnel from more points of attack and speed its progress.

The mouth of the side-hill adit was located almost under the stamp mill tramroad, about half-way between the mine and mill.[75] The adit was driven perpendicular to the strike of the Pewabic Lode. It would have to be driven over 1000 feet before striking the Pewabic -- that is, if the lode existed at all on Quincy's southern ground.

In 1865 the company continued the adit and its shafts, and miners tested all the veins of copper rock which they discovered. They drove the adit some 600 feet and holed it to the two shafts. The company spent $35,434 in the effort,[76] but the results were disappointing, as reported in the 1865 Annual Report:

> The necessity of making this new set of openings arises from the fact that, in the south end of the mine, a piece of disturbed ground is encountered in the place of the Pewabic Lode, that is entirely foreign to it or to the belts that inclose it. An opening of some six hundred feet into this ground, has failed to disclose any vein that will pay for working, and it seems probable that the Pewabic Lode does not exist in it, except in detailed fragments.

Still, the work would continue, largely at the insistence of the agent, George Hardie:

> If it is so found, the adit will afford the means of opening and working a large amount of ground, without expensive machinery, as it brings out the broken rock at a convenient place for removal to the stamps, and is so large and straight that horses can be readily worked in it. This work is of great importance to the future development of the company's property, and promises at no distant day to add materially to the product of the mine.[77]

The company spent $13,356 on the side-hill exploration in 1866; $3,014 in 1867; and $1,414 in 1868.[78] Altogether, Quincy spent approximately $53,000 on the work and drove the adit 1160 feet. The company learned a great deal about its property in the process, but it did not learn the whereabouts of the southern end of the Pewabic Lode, or of any other workable lodes of copper. The southern ground still was a puzzling disappointment. At the end of the 1860s the mine's operation was confined to shafts 2, 3, and 4. Number 3 closed by 1872, leaving only Nos. 2 and 4, located just 640 feet apart in one small portion of Quincy's property. Those two shafts alone would sustain the company for the next twenty years.

NOTES -- CHAPTER ONE

[1] Dr. James Fisher, "Historic Sketch of the Lake Superior Copper District," Keweenawan (1934), p. 254.

[2] Note regarding finds of mass copper written on QMCo drawing by S.W. Hill, Nov., 1859, "Longitudinal Section of Quincy Mine."

[3] B. S. Butler and W. S. Burbank, The Copper Deposits of Michigan. U. S. Geological Survey, Professional Paper 144(Washington, 1929), p. 65.

[4] Ibid., p. 98.

[5] The various veins or lodes in the vicinity of Quincy are shown most clearly on a c. 1865 map of the adjacent Pewabic Mine, incorporated as part of the HAER drawing set

[6] QMCo Contract Book, 1856-1860. Numerous entries cover work at shafts 1, 2, and 3 on the Quincy Vein.

[7] Ibid. Contracts for work on the Quincy Vein cease in this volume after October, 1858.

[8] Ibid. The first references to underhand stoping appear in contracts for July, 1859.

[9] The winzes show clearly in all early sectional drawings of the mine and are covered in QMCo Contract Books.

[10] The shafts discussed in this report and shown on the HAER maps as Nos. 1 through 6 were not sunk in that order. The shaft numbering system used here was adopted by Quincy on January 1, 1859, when the company renumbered its shafts, putting "No. 1" near the Pewabic boundary and numbering consecutively as it moved towards the south. Thus the earliest shafts (old Nos. 1, 2, and 3) became known, respectively, as Nos. 4, 3, and 2. See QMCo Contract Book, 1856-1860, p. 140.

[11] QMCo drawings, "Longitudinal Section of Quincy Mine, Nov., 1859; "Longitudinal and Vertical Projection," Nov., 1861.

[12] QMCo Invoice Book, 1860-1863, records extensive purchases of candles in all of those years. In 1863, for example, Quincy purchased 66,676 pounds of tallow candles. In 1865 Quincy built its own "candle factory," which burned in 1872. (See QMCo 1865 Annual Report, p. 14; A. J. Corey to Rogers Todd, Nov. 20, 1872.) In 1865 Quincy had employed its own candlemaker. But before the candle factory burned, it had switched to providing the candlemaker with tallow and wicking and to buying his candles back at 1 3/4 cents per pound.

[13] T. Egleston, "Copper Mining on Lake Superior," AIME Transactions, VI, 1879, p. 290.

[14] For example, "Contract (for three men) to Wheel Rock from North of No. 3 Shaft (2nd Level)," April 30, 1859. Numerous wheeling contracts are found in QMCo Contract Book, 1856-1860.

[15] Unfortunately, the capacities of all of Quincy's early tram cars remain unknown.

[16] In mid-1860 Quincy purchased 48 wheelbarrows at one time. It is not clear if they were for under- or above-ground work, or both. (May 29, 1860 invoice from G. O. Williams in QMCo Invoice Book, 1860-1863. The figure for the rail tonnage comes from QMCo "Inventory" of Jan. 1, 1862.

[17] July 2, 1863 and June 23, 1864 invoices record two early purchases of draught animals. QMCo Invoice Book, 1860-1863 and 1864-1865.

[18] This discussion of the treatment of mass copper is largely drawn from T. Egleston, "Copper Mining on Lake Superior," pp. 285-287. The methods described by Egleston in this 1879 publication seem to have been applied from the earliest days of mining on the Keweenaw up until the acceptance of high explosives and the advent of machinery for cutting mass.

[19] T. Egleston, "Copper Mining on Lake Superior," p. 287.

[20] The early contracts to "Hoist Rock and Water" or for "Hoisting and Landing" typically ran for one month. A single contract might cover the work of anywhere from three to twelve men. The larger teams were often responsible for hoisting from more than one shaft. See numerous entries in QMCo Contract Book, 1856-1860.

[21] It is clear that in c. 1860, Quincy used two sizes of kibbles. The smaller weighed 550 to 650 pounds; the larger about 1000 to 1400 pounds. It seems likely that the 600 pound kibbles were used with windlasses, and the larger ones with hoisting engines. In QMCo Invoice Book, 1860-1863, see invoice for large kibbles from the Detroit Locomotive Works, Oct. 26, 1860, and from J & J Brennan, June 4, 1862. In QMCo Invoice Book, 1864-1873, see "Account of Old Iron to be Shipped to Wyandotte Rolling Mills, " Sept. 12, 1864, which covers the scrapping of 6 old kibbles weighing a total of 3682 pounds. According to the Portage Lake Mining Gazette, Dec. 3, 1864, a (large) kibble's capacity was just over a ton.

[22] QMCo "Inventory of Buildings, etc.," March 1, 1859; and S.S. Robinson to T.F. Mason, May 14, 1861.

[23] QMCo Contract Book, 1856-1860, p. 136.

[24] QMCo, "Inventory of Buildings, etc.," March 1, 1859.

[25] QMCo, New York Office Journal, 1857-1872, p. 24. Unfortunately, very little information regarding the physical characteristics of Quincy's early hoists, or information regarding their manufacturers, has been found. George M. Bird & Co. is listed in Boston's city directory in 1852 and disappears by 1877. J. B. Wayne & Co. and Jackson and Wiley were both formed in Detroit in the 1850s and seemingly disappeared by the 1880s. Quire, Hodge & Christie, another Detroit firm, began in 1863 and by 1865 had become Hodge & Christie. This name lasted until 1883, when the company became known as Samuel F. Hodge and Co. No trade literature has been found which would illustrate any engines such as those first used by Quincy.

[26] Entries for June and July, 1859, in QMCo Returns of Labor, 1857-1864, and Contract Book, 1856-1860.

[27] "Articles of Agreement, 16 Nov. 1859, between J. B. Wayne & Co. of Detroit and the QMCo."

[28] QMCo, Returns of Labor, 1857-1864, statement of August, 1860.

[29] S.S. Robinson to T.F. Mason, May 14, 1861.

[30] QMCo Day Book, 1859-1866, p. 110.

[31] In 1860, for example, Quincy entered windlass contracts at "No. 4 Shaft from the 4th Level," and also at Nos. 3 and 5 "from the 4th Level." See Contract Book, 1856-1860, pp. 385, 449-453. In general, Quincy's early "hoisting" contracts seemingly involved bringing rock to the surface, while its "windlass" contracts involved lifts that started and stopped underground.

[32] S.S. Robinson to T.F. Mason, May 14, 1861.

[33] QMCo 1862 Annual Report, n. p.; S.S. Robinson to T.F. Mason, Jan. 30, 1862.

[34] QMCo 1863 Annual Report, p. 14; 1866 Annual Report, p. 14. These sources mention friction gears (or parts of friction gears.) For an illustration of a friction gear interposed between an engine and a hoisting drum, see Figure 486 in George G. Andre, A Descriptive Treatise on Mining Machinery, Tools and Other Appliances (1877-1878) vol. II.

[35] QMCo Time Book, 1861-1862.

[36]Records of the purchases of "bell-wire rope" are found in QMCo Day Book, 1859-1866, pp. 324, 346, 347, and 586.

[37]No detailed drawing of an early shafthouse survives, and the earliest photos date from c. 1875. The best illustrations of early shafthouses appear on QMCo drawing, "Longitudinal and Vertical Projection," Nov., 1861.

[38]Kibbles seemingly were designed so that they could be hooked onto at the bottom and tipped. Illustrations of kibbles show a heavy iron "handle" on the bottom, and the surviving kibble at the Houghton County Historical Society has this feature.

[39]A Quincy "Inventory of Tools and Supplies at the Mine," dated Jan. 1, 1864, lists 4 "Shaft House Cars." It is possible that the rock first went into a storage bin, and from that went into the cars. The 1863 Annual Report, p. 12, suggests that the early shafthouses had some storage facilities; it notes the construction of a "Rock Receiver" at the No. 3 shaft.

[40] See HAER's c. 1864 map of Quincy, which shows the shaft and sorting houses.

[41]The kiln-houses are shown on HAER's c. 1864 map. The QMCo Day Book, 1859-1866 and Surface Book, 1867-1870, indicate that from 1860 to 1870, 3 kiln houses were usually in use, with 4 in operation in 1863 through part of 1865. The first contract for "burning copper" seems to have been entered into in Sept., 1858; prior to that rock was broken without calcining. Even after kiln-houses were introduced, some rock was broken without the aid of fire. S.S. Robinson, in a letter to T.F. Mason of May 14, 1861, noted that rock from No. 1 was simply dumped next to the tram road and broken without being burned.

[42]Records of this work survive in QMCo Contract Book, 1856-1860, and in QMCo Kiln-house Time Books, 1861-1862 and 1862-1866.

[43]O. W. Robinson, "Recollection of Civil War Conditions in The Copper Country," Michigan History Magazine, III,4 (1919), pp. 598-599.

[44]The QMCo "Inventory of Tools and Supplies," Jan. 1, 1864, lists 30 "rock cars." It is not clear if these were surface cars, underground tram cars, or a total for both.

[45]QMCo 1862 Annual Report, n.p. The original tramroad was strap iron affixed to wooden string pieces. An invoice dated October 3, 1860 for the Wyandotte Rolling Mill Co. carries the order for 367 bars of "strap rail." In 1868 Quincy rebuilt the tramroad, using 20-pound T-rails and building timber trestles over depressions to make the grade as constant as possible. QMCo 1868 Annual Report, pp. 15, 18; invoices for T-rails, June 19, 20, and 22, 1868.

[46] The capacity of the cars is not known. Quincy ordered its wheels, axles and bearings from foundries, but built its own car bodies. The cars apparently had 16-inch wheels on the downhill end, and 12-inch wheels on the uphill end, which would have kept the car bodies more level. See QMCo Engineer's Time and Day Book, 1864-1873, entry for April 1871; invoice for car wheels, June 29, 1860, QMCo Invoice Book, 1860-1863.

[47]QMCo, "Cost of Running Tram Road, August, 1861.

[48]See numerous entries covering chain purchases in QMCo Invoice Book, 1860-1863. The last order for hoisting chain is found in Invoice Book, 1864-1873.

[49]"Inventory," Jan. 1, 1862. As of this date the use of wire rope had just started, and 21,760 pounds of chain were still in use.

[50]Numerous entries, QMCo Invoice Books, 1860-1863 and 1864-1873. These invoices were used to calculate the relative weights and costs of chain and wire rope.

[51]S. S. Robinson to T.F. Mason, May 14, 1861.

[52]The Minesota Mine resorted to skips early in 1862, when its deepest shafts were at 800 to 975 feet. "Report of the Board of Directors of the Minesota Mining Company," March 19, 1862, p.5.

[53]QMCo Invoice Book, 1864-1873. An invoice dated July 26, 1864 gives the dimension of skip bottoms as 60" x 44" x $^1/_2$".

[54]The Invoice Book, 1870-1872 records a Sept. 30, 1872 purchase of 12" skip wheels.

[55]Portage Lake Mining Gazette, Dec. 3, 1864, p. 2.

[56] Several entries covering the first skip purchases are found from June through Sept., 1863, in Invoice Book, 1860-1863. The invoices indicate that the first skip bodies weighed from 1800 to 2000 pounds.

[57]QMCo 1864 Annual Report, p. 17.

[58]QMCo 1865 Annual Report, p. 17.

[59]QMCo 1866 Annual Report, p. 4: "It is direct and safe in its action, compact and highly creditable to the executive officers and mechanics of the mine, who designed and erected it." One of the best descriptions of the working of a man-engine is found in "A Day in a Copper Mine," Portage Lake Mining Gazette, July 22, 1869. This account related experiences at the Pewabic Mine.

[60] QMCo 1866 Annual Report, p. 12. Repairs and extensions of the man-engine are regularly reported in the Annual Reports until the 1890s.

[61] For example, see contract, Aug. 27 to Sept. 28, 1857, in QMCo Contract Book, 1856-1860.

[62] QMCo Annual Reports make several mentions of cisterns at the mine. Although there is no direct mention of using underground water for the boilers, this practice was definitely in force at the neighboring Pewabic Mine. See Pewabic 1861 Annual Report, p. 16.

[63] QMCo Day Book, 1859-1866, pp. 93, 126; Returns of Labor, 1857-1864, account for Dec. 1862; Invoice Book, 1860-1863, invoices for April 19, 1860 and May 27 and Nov. 4, 1862.

[64] QMCo Returns of Labor, 1857-1864, account for Sept. 1863; Invoice Book, 1864-1873, invoice for July 20, 1864; QMCo 1864 Annual Report, p. 12.

[65] Barren zones in the mine are well defined on numerous longitudinal sections of the mine that show the progress of shaft-sinking, drifting and stoping. In the 1872 Annual Report, A. J. Corey wrote that, ". . . our vein is of a peculiar character; as a rule well defined and rich in places, in 'pockets,' well filled with copper, but with stretches of barren ground intervening." (Page 18.)

[66] Portage Lake Mining Gazette, April 15, 1869.

[67] QMCo 1868 Annual Report, pp. 7, 16, and 21. Also 1870 Annual Report, p. 18.

[68] In the Quincy 1871 Annual Report (p. 15), for example, the old No. 1 shaft is referred to as a winze, and the 1872 Annual Report (p. 19) refers to the No. 3 shaft as a winze.

[69] Shaft closings were marked by a decreasing number of entries (and ultimately, no entries) in QMCo Surface Books, 1864-1865 and 1867-1870. Closed shafts also ceased to be mentioned in the Annual Reports.

[70] QMCo 1867 Annual Report, p. 15.

[71] S. S. Robinson to T.F. Mason, May 14, 1861; QMCo 1862 Annual Report, n.p.

[72] QMCo Engineer's Time & Day Book, 1863-1870. Entries for April and September, 1869, for example, charge the engineer's time at No. 6 to the tasks of sawing wood and repairing a corn mill.

[73] Numerous contracts covering this work are recorded in Contract Book, 1864-1866. See especially contracts for Sept.-Dec., 1864.

[74]QMCo 1864 Annual Report, p. 5.

[75]The route of the adit is shown on HAER's c. 1864 map of the Quincy Mine Location.

[76] QMCo 1865 Annual Report, p. 5.

[77]Ibid., p. 6. The emphasis on working the vein through an adit in the hillside is interesting. Some evidence suggest that Quincy's very early explorations in the 1850s had concentrated on the hillside, so that if copper were found it could be reached by an adit, and not by shafts sunk in the hilltop. In c. 1853, Ransom Sheldon employed Edwin J. Hulbert to survey "from the shores of Portage Lake along his road to the diggings at the Quincy Mine . . . . In his foresight he contemplated, the opening of an adit, both for water-way and transport of rock to the Lake shore . . . , avoiding the hoisting of rock to that height (the summit of the hill) to be delivered by wagon down the steep incline." See Edwin J. Hulbert, Calumet-Conglomerate (Ontonagon-Miner Press, 1893), pp. 69-70.

[78] QMCo. Annual Reports, 1866, p. 4; 1867, p. 11; 1868, p.14.

CHAPTER II

The years from the early 1870s to the early 1890s constitute a definable period in Quincy's history. The same two shafts accounted for all production and Quincy's boundaries remained the same. The exploratory and early productive periods had ended, and for twenty years -- each one of them profitable -- Quincy rooted in and exploited the Pewabic Lode solely through Shafts 2 and 4. The period ended in 1891-1892, when Quincy pushed out its boundaries and started to make itself over, both above and below ground.

Characterizing these twenty years as a cohesive period is not to imply that little development occurred. Quincy's production level took one big jump during this time and readied itself for a second, and although Quincy continued some of its technologies, little changed, it significantly altered others.

If the figures for Quincy's 19th century production of copper ingot are plotted and connected, the resultant line does not climb steadily by regular, small increments.[1] Instead, it defines a series of production plateaus. When the company's production rose, it tended to jump dramatically. Then it would level off and remain fairly constant for a number of years before jumping up again. In the first half of the c. 1870 to 1892 period, Quincy's production continued on the plateau first reached in 1864.

From that date until 1880, save for the three bust years immediately following the Civil War, Quincy produced 2.3 to 3.6 million pounds of ingot per year. In 1881 production jumped suddenly to 5.5 million pounds, initiating another plateau that lasted through 1889, when 6.4 million pounds were smelted. In 1890 to 1892, Quincy moved towards a still higher plateau, producing 8, 10.5 and then 11.1 million pounds. From 1893 to 1900, production again levelled off at 14.1 to 16.9 million pounds of copper. 1901 brought another rapid, one-year jump to a plateau characterized by an annual production of some 20 million pounds.

Technological changes and substantial improvements to the mine's physical plant almost always attended the jumps from one production plateau to the next, even if they alone were not responsible for the increases. But changes did not come only during the "jump" years; many came in the middle of a plateau and left the production level unaffected. Quincy's goal was not always to do more, but often to do the same amount at less cost.

By 1871 Quincy miners were working at the 180 to 200 fathom levels. In his portion of the Annual Report for that year, James North Wright, the mine's Agent, noted that this depth rendered necessary "a much larger expenditure" for "new machinery and equipment . . . . to enable us to prosecute, with economy and success, our work in (the) future." North advocated more mechanization, specifically the introduction of air drills and rock-crushers. Their initial expense would be large, he wrote, but once in operation their value would be "rapidly returned to the company in the great saving of time and diminished cost of production."[2]

Quincy's President, Thomas F. Mason, concurred with North regarding the sagacity of introducing "appliances for lessening the cost of breaking and handling the mineral."[3] So did the other company directors. At a meeting in April, 1872, the directors authorized Wright to expend $100,000 to upgrade the mine's facilities and equipment.[4] Air drills and rock-crushers were purchased and put to use. Because these two machines were to be of great import to the mine, they are discussed here in advance of all other changes that occurred between 1870 and 1892.

In October 1872, Quincy deployed its first air drills in drifts along the 190 and 200 fathom levels, south of the No. 2 shaft.[5] The company did not simply exchage one tool (the air drill) for another (the hand drill). Air drills required a more complex and expensive support system: boilers to generate steam; steam engines to drive air compressors on the surface; cast-iron pipes to conduct air down the shafts and along drifts; flexible hoses to carry air from the pipes to work areas; and the drilling machines themselves, along with their assorted posts and mounts. In 1872 Quincy's "air compressor and drill account" amounted to $25,093, and after this considerable outlay only a few drills were in operation.[6] Quincy had ordered three "tunnel drills" and two "mining drills" from the Burleigh Rock Drill Company in July, 1872.[7] Taken with all their hardware, the five drills cost $3,997. But Quincy had only two drills in hand by the end of the year, and the company was meeting with scant success in their use.

The switch to air drills was predicated on the belief that they would drill faster than miners single- or double-jacking hand drills. Because the air drills were faster, miners could drill more holes in one shift, or deeper holes. In either case, the subsequent blasts would free a greater quantity of rock. But the first air drills broke little more ground than hand drills, and they did not boost production enough to compensate for their cost of operation.

The miners, unfamiliar with the drills and their operation, were slow in setting the machines to work.[8] But this problem apparently was short-lived. The larger, more lasting problem lay not with inexperienced men, but with the machines themselves. They were too big and therefore ill-suited to Quincy's smallish openings. To try to accommodate the machinery, Quincy tested them along special 10-foot by 10-foot drifts, which were over three times larger in cross-sectional area than the usual 5 x 6 drifts. Given this increased elbow room, the air drills still proved disappointing. On December 7, 1872, A. J. Corey wrote the Burleigh company that:

> "Although when in position they have worked well, it has taken so much time to handle them, that it has cost us considerable more than it would have (if) done by hand power. If we do not improve this month we will stop Drifting with them and try them in underhand stopes.[9]

Exactly one month later, Corey reported on the drills' performance to W. R. Todd. Miners with the air drills could push a 10 x 10 drift "a little more rapidly" than their counterparts driving a common 5 x 6 drift by hand, "but without any material saving for the cost of the work." The cost of the large drift was partly determined by the nature of the rock. When air-drilling through rich ground, the copper recovered from the drift could make the method pay. But as Corey noted, "we cannot afford to carry a 10 x 10 drift through poor ground."[10]

The first Burleigh drills were too heavy for two miners to move readily and too cumbersome and long to allow miners to position holes precisely where they would have the greatest effect. What was needed, Corey wrote, was a "drill small enough to work to advantage in our small drifts and light enough for two men to carry anywhere, say about 175 lbs. weight."[11]

Quincy had sought a smaller drill from Burleigh in the summer of 1872 and still pressed for its receipt in November and December.[12] The drill finally arrived in mid-1873. In the meantime, Quincy borrowed and tested a "compact," 200-pound Wood drill, which proved unsuccessful because it was "liable to trifling accidents."[13] The first "little" Burleigh stoping drill, costing $550, arrived in June, 1873 and a second arrived in August. (The total power drill account for 1873 amounted to $1,464.)[14] Quincy thought better of these machines, but they too broke little more ground than hand drills. In Quincy's 1873 Annual Report, the Agent wrote that the Burleigh drills had done "fair duty" in some instances, but they had not been successful enough to "warrant their general introduction into the mine."[15] Quincy seemingly took its few drills out of service and backed away from investing any further in air drills, compressors and pipelines until machines were available that were clearly less expensive to operate and faster than hand drills. Those machines did not arrive for another six years.

The machines that made the difference were the No. 2 and No. 3 drills manufactured by the Rand Drill Company. Quincy purchased one No. 2 drill in June 1879 for $400 and entered its first "Rand Drill Contracts" with miners in August.[16] At this time Quincy apparently reactivated one of more of its Burleigh drills, perhaps to run the Burleigh and Rand machines in a head to head competition.[17] If so, the Rand drills won out. The Burleigh drilling contracts quickly disappeared and Quincy bought three more Rand drills in June 1880 and another two drills in September, by which time their price had fallen to $360. Despite some problems of a lack of power for driving the drills, Quincy found them to be of "great advantage in many places in the mine."[18]

The success of the Rand machines prompted Quincy to improve and enlarge its air-drilling facilities. The mine's original air compressor, purchased from C. H. Delamater in 1872 for $7,000,[19] was too small to drive many units, so in 1881 Quincy supplemented it with a new Rand Duplex Compressor costing $8,000.[20] This machine, housed in a new stone building just north of the No. 4 shaft, had two steam and two air cylinders, each with a bore of 16-$^1/_2$ inches and a 30-inch stroke. Rand guaranteed that when providing air at 60 psi, the compressor could drive as many as sixteen No. 3 Rand drills. In 1881, Quincy purchased twelve "Little Giant" No. 3 drills from Rand. Each cost $450 with a mounting column, or $400 without.

Quincy continued to augment its complement of Rand equipment. By 1884 the Delamater compressor was deemed not only too small, but too inefficient, so Quincy added a second Rand Duplex Compressor.[21] That year Quincy operated 20 Rand drills, and by 1889 John Cliff, the Mining Captain, regularly reported to the Agent that 23 to 25 air drills worked in the mine.[22] Quincy deployed about two-thirds of the drills in stopes, and the remainder in drifts and shafts. Air drills had by no means eliminated hand drills, but they had come to predominate the earlier tool. Quincy employed an average of 145 miners in 1889. The 25 air drills operated during both shifts, and each drill required two operators per shift.[23] So in 1889 some 100 of Quincy's 145 miners were drilling with machines.

The adoption of air drills went hand-in -hand with another important change: the switch from black powder to high explosives. The two changes should be considered together because they occurred together. In the 1879 Annual Report, A. J. Corey wrote: "It is becoming more and more evident that for the future cheapening of our mining costs, we must place more reliance upon the use of power drills and high explosives."[24]

Prior to 1878 Quincy used black powder exclusively. The mine purchased this material in large lots and stored it in a powder house. Extant Quincy invoices carry no mention of DuPont saltpeter powder until 1878, but other evidence suggests that the mine used it at least by the early 1870s. In 1874, William Rogers Todd in New York took the liberty of ordering, on trial, 50 kegs of a soda-based explosive from the Oriental Powder Mills of Boston.[25] In doing so, he touched a nerve. The choice of powder was, and continued to be, one of the more sensitive issues at Quincy, and one that sometimes caught the mine's Agent in the middle. He had to answer to the miners on his doorstep, who cared about safety, reliability and noxious gases, and to company officers in the East, who were more concerned with bottom-line costs. In this instance, Corey objected to the receipt of any soda powder, writing that the mine had tried and "condemned it years ago." It did "good work while fresh," but no soda powder had stood "the test of time and climate."[26] Corey put his faith in DuPont saltpeter powder: "The Dupont has proved without exception the best powder in use on the Lake and gives universal satisfaction among the men, and by actual test breaks from 25 to 33 percent more ground than any soda powder."[27]

Corey tried the Oriental powder and found it lacking; that conclusion is borne out by an 1878 purchase of 1000 kegs of DuPont blasting powder.[28] In the same year, however, Quincy made its first, albeit meagre, purchase of a high explosive: 400 pounds of No.2 "Hercules Powder" from the California Powder Works.[29]

By 1880, when Quincy purchased 2,517 kegs of saltpeter powder, the amount of Hercules Powder had risen to 21,750 pounds.[30] In 1881 Quincy continued to buy saltpeter, but instead of purchasing more Hercules, it switched to 540 boxes of "No. 2 Excelsior," purchased through John Sarter of Eagle River, a community north of Quincy on the Keweenaw Peninsula. In 1882, Quincy mixed its purchases even more: 140 kegs of black powder; 1944 boxes of No. 2 Excelsior; and 8,250 pounds of "Diamond J" powder from J. H. King in California.[31] So the years 1878 to 1882 -- just those years when Quincy firmly committed itself for the first time to air-drilling -- were experimental ones, in terms of powder. Black powder remained in use, but several high explosives were tried. By 1884, in an average month Quincy consumed 26 kegs of black powder and 9933 pounds of high explosives.[32] The high explosive which had proved best was the No. 2 Excelsior, as agent S. B. Harris noted:

> The high explosive used in the Quincy for some time past is the No. 2 "Excelsior," manufactured at Marquette. . . . The grade used here is 50 percent, price 31 cents per pound. They (the miners) like this powder here better than any other they have used.[33]

Although Quincy relied most extensively on a high explosive that was 50 percent nitroglycerine, it did not use that product exclusively. In the copper region, powders varying from 40 to 65 percent nitroglycerine were commonly offered for sale, with the higher concentrations bringing higher costs per pound. The final selection of powder depended on trial-and-error test under actual working conditions. Generally speaking, the goal was to buy the cheapest powder that did an effective, efficient job on the rock found in a given mine -- and a powder was to be safe, predictable, and enjoy the favor of the miners. Quincy eschewed "suspect" powders. In 1874, 100 pounds of Dualin mysteriously exploded in the Mining Captain's office at the Phoenix Mine. Quincy's Agent, A. J. Corey, chalked it up as "Six more victims to the little understood, possibly unknown, properties of Dualin."[34]

Another key factor in determining powder selection -- and one which shows the tie between the drilling and blasting technologies -- was the size of the drill steel that was used. Here there was clearly a grade-off. Quincy's management had to weigh the relative merits and costs of drilling larger holes (which could be tamped with lower-grade explosives), or of drilling smaller holes and resorting to more expensive and powerful explosives. In 1884 Quincy experimented and tried to expedite its drilling and blasting. First it changed from the standard "cross-bit" drill to a straight chisel-bit, like the tip used on hand drills.[35] At the same time it reduced its hole sizes, apparently from about $1\text{-}^{1}/_{4}$ inch down to one or three-fourths of an inch. These changes allowed the Rand drills to cut through one-third more ground per shift. To properly explode the rock from the smaller holes, Quincy also experimented with a 65 percent powder. The combination of smaller holes and more powerful explosives proved an advantage only in certain parts of the mine, however, and Quincy fell back to 50 percent powder.[36] So in a sense, Quincy was middle-of-the-road when it came to explosives; it used neither the strongest nor the weakest explosives available.

The introduction of air drills and high explosives coincided with Quincy's 1881 production jump to 5.5 million pounds of ingot copper, nearly a 50 percent increase over the previous year's 3.7 million pounds. At the same time the mine's running expenses increased by only 3.5 percent, from $366,000 to $379,000; and the number of miners by 10 percent, from 192 to 212. All of this was achieved, despite the fact that at the beginning of 1881 Quincy had only six No. 2 Rand drills on hand. Twelve No. 2 Rands were added in 1881, but not until late in the year; the invoices for the purchases of two, four, and then six drills were dated August, September and October. Quincy began 1882 with 18 Rand drills, ended with twenty-two, and production reached 5.7 million pounds of ingot. Significantly, this figure was attained by a much smaller force of miners: only 152. In the five years ending in 1880, Quincy's production averaged 3 million pounds of ingot; its number of miners, 222. In the five years starting in 1881, its production averaged 5.7 million pounds; its number of miners, 164.[37]

It seems there was a strong correlation between air drills/high explosives and increased production/fewer miners. Unfortunately, however, it is presently not possible to make direct comparisons between the old and new technologies; to see just how the cost of stoping a cubic fathom decreased; or to quantify the increased productivity of miners armed with air drills. Through 1877 Quincy's Annual Reports are very thorough in detailing the mine's production and costs. In the critical years of 1878 to 1880, the Annual Reports are extremely meagre by comparison. They improve again in 1881 and thereafter, yet never again are they as rich in data as in earlier years. Consequently, we are left with the strong impression that air drills and high explosives both boosted production and lowered costs. In gross terms, production increased by half; the number of miners decreased by one-fourth. But it would be erroneous to attribute all of this improvement to air drills and high explosives. Several factors should be considered for their effects on production, even if those effects are not well defined.

Price may have been important. In the 1870s, Quincy had sustained its profitability, even though copper prices had plummeted to low levels. In 1881, the price of copper ingot rose several cents per pound, and this increase may have caused Quincy to emphasize production instead of development work. The company may have deployed more of its miners in stoping, at the expense of shaft-sinking and drifting.

This change in emphasis seemingly was made possible by the inordinate amount of development work Quincy had done in the late 1870s -- work that had opened up large stretches of the lode and left them ripe for picking just when the Rand drills and high explosives came along. In 1871 through 1874, Quincy regularly drifted a total of 1975 to 2050 feet. The total increased rapidly, until it was nearly doubled in 1877, when Quincy drifted 4056 feet.[38] The mine concentrated on extending its existing levels, and the 1877 Annual Report gave a reason why:

> No sinking has been done in either of the main shafts during the year, it being thought more desirable to push out our levels north and south. This was not from a want of confidence in the permanency and value of the lode in depth, but rather to open up the large amount of undeveloped ground to the north and south ends of the mine, and also to defer the unavoidable necessity of new and more powerful machinery, which a too rapid sinking would bring upon us in the course of a few years.[39]

In short, Quincy's hoists had about reached their maximum depths, and the company decided to more fully open up the length of the lode, instead of going further down. So by the time the Rand drills arrived, a large amount of very good stoping ground was available and ready to be worked. Having just emphasized development, the mine turned to emphasize production.

A change in management accompanied this change in philosophy and may have hastened it. In February, 1881, A. J. Corey died unexpectedly, and Frank G. White replaced him as Agent.[40] White's tenure was brief. He lasted only until the end of 1883, when S. B. Harris assumed the Agent's role. White, in seeking to make a good first impression, may have emphasized production in order to reap maximum profits from the rise in copper prices. If so, he was successful in this endeavor. In 1881 through 1883, Quincy's dividends ran $320,000, $520,000 and $380,000; only once before had Quincy ever reached the $300,000 figure. But a later critic would suggest that White ran into difficulties at Quincy because he had seen too many faults when arriving, and he had tried to move too fast in changing the operations.[41]

A final and very significant cause -- or partial cause -- of the production jump in the early 1880s must be cited. Quincy, as noted earlier, was a "bunchy" or "pockety" mine: very rich in some areas, very modest in others.[42] In the early 1880s Quincy hit the richest ground it would ever work. The mass and barrel copper content of the rock was high, and the rock yielded record amounts of refined copper per cubic fathom of ground stoped. In 1881, mass accounted for about 10 percent of the mine's total production, and the yield of finished copper per fathom was 767 pounds. That figure rose to 800 pounds in 1882 and to 850 pounds in 1883. These yields are much higher than those recorded in the 1870s. From 1870 to 1877, Quincy averaged 485 pounds of ingot per cubic fathom.[43] Because of the richer ground, with air drills or not, Quincy could have boosted its production, even if it had stoped less. So in a sense the production jump in the early 1880s was a providential (or geological) fluke. S. B. Harris noted this in 1884, as he neared the end of his first year as Agent:

> . . . The Quincy has been pushed too hard in point of production since Mr. Corey's time. It is all very fine while those abnormally large bodies of copper continue, but we can't expect them to last forever, and with only ordinary good stamp rock -- with but little

> mass or barrel copper -- we could not keep up much of a product with our present stamping facilities.[44]

Unlike the first air drills purchased in 1872, another type of machine -- the mechanical rock-crusher -- met with immediate favor. Quincy had thought of substituting this machinery for kiln-house work and calcining at least as early as 1863. In that year's <u>Annual Report</u> the mine's Agent, S. S. Robinson, wrote that the company should consider "the purchase and erection of a 'rock-crusher,' if we can be reasonably sure of getting one that will be useful and effective."[45] Yet in the next <u>Annual Report</u>, Robinson had to rule out this acquisition. Because of the Civil War and the "pressure of work in all the machine-shops of the country, it has been too expensive and too difficult to get work done, to attempt any experiments with 'rock-crushers.'"[46]

Throughout the war, Quincy relied on heat and hand-sledges and picks to reduce its rock to a size small enough to enter the stamps at the Portage Lake mill. After the war, dismal economic conditions and a depressed copper market caused Quincy to again forestall the acquisition of crushers. But by 1871, the demand for copper had risen temporarily, along with its price, and John North Wright, then the Agent, foresaw an era of higher wages for laborers. To meet such a contingency, and to reduce labor and thus cheapen the cost of production, Wright recommended "that a rock house be built near the head of (the) tramway incline, to be furnished with a full set of Blake's rock-breakers, and connected by a railway with the working shafts of the mine. . . ."[47]

The heavy-timbered rock-house, begun in 1872 and completed in 1873, was the most expensive structure Quincy had ever erected at the mine, when the cost of its machinery was counted in. In 1872, Quincy spent $25,386 on the rock-house and its breakers and other equipment. In the following year it expended an additional $14,915. The new "railway" or tramroad that ran south from shafts 2 and 4 to the rockhouse was constructed in 1872-1873 at a cost of some $18,000.[48]

No detailed plans or descriptions of Quincy's original rock-house survive. It is impossible to recreate a precise flow of materials through the structure or to see just how labor was applied to discrete tasks. However, a broad picture of Quincy's early rockhouse practice can be drawn. The structure housed wood-burning boilers and two reciprocating steam engines. One engine powered the endless-rope tramroad that pulled full cars from shafts 2 and 4 to the rockhouse, and then returned them empty. Sitting on the southern end of the mine, the rockhouse was downhill from the shafthouses. The tramroad, in its final approach, was elevated on a trestle. The cars dumped their contents into the upper level of the rockhouse, so gravity feeds could be used to move and sort rock.

A second steam engine, through belts, pulleys and shafts, drove six major pieces of equipment. The Blake Crusher Company (New Haven, Connecticut), for a total of $8,000, provided five crushers that compressed rock between heavy iron jaws to break it. A single 24" x 18" crusher cost $3,000, and four smaller crushers, measuring 15" x 9", 18" x 9", or 15" x 10" (the sources are contradictory), cost $1250 each.[49] The sixth piece of equipment driven by the engine was a heavy drop hammer designed by the Superintendent of Quincy's stamp mill. The hammer's head (weighing slightly over a ton) could be raised vertically in guides and then released to fall free.[50] The rockhouse contained a second hammer, whose much smaller head was moved directly by its own steam piston.[51] (There is some evidence that this steam hammer was used only briefly in the rockhouse.)

This machinery was installed in the midst of a series of iron grates (or "grizzlies"), slides, hoppers, and bins that sorted, moved, or stored material.[52] The machinery replaced much of the arduous hand-labor conducted at the three or so kiln houses which Quincy operated in 1871, but by no means did it totally eliminate such labor. Men still had to push, drag, carry, or pick over a great deal of rock and copper mass by hand. When rock went down the structure, gravity moved it; when it moved across the rockhouse, men moved it.

Within the rockhouse, firemen and engineers controlled the powerplant and brakemen operated the tramroad.[53] Laborers segregated the poor rock, mass copper, barrel copper and stamp rock. The waste rock was discarded. The free-falling head of the large drop hammer cleaned mass copper of adhering rock; the smaller steam hammer, at least initially, cleaned the barrel work. Stamp rock, by far the most abundant material, was sorted by size, and the pieces too large to go directly into the stamps at the mill were reduced in the crushers.

It is impossible to determine just how many times stamp rock had to be handled, or just how far it travelled in moving from one step to the next. Upon arrival, the rock passed over a slightly sloped iron grate or grizzly. The spacing of the bars sorted the rock by size. The rock small enough (about 3 inches or less) to pass through the grizzly was small enough to enter the mill's stamps. Needing no further reduction, this material was chuted to a storage bin, and from there it could be loaded into vehicles for transporting to the stamp-mill tramroad.

The rock that did not fall through the grizzly probably was drawn out onto a heavy floor, where men sorted it by hand. If small enough, the rock went directly into one of the small crushers. Larger rock was passed into the large 24" x 18" jaw crusher. When it passed through the bottom of this machine, it fell into a 15" x 10" crusher. Laborers stationed in the rockhouse probably fed the crushers by hand, all the while keeping an eye out for barrel work -- picking it out to assure that gummy, fist-sized pieces of copper did not enter and jam the machine's jaws. Once material had passed the small crushers, it was chuted to storage bins.

The basic components of Quincy's 1871-1872 rockhouse -- a steam engine with shafting; an elevated dump and rock receiver; grizzlies; large and small jaw crushers; a drop hammer; a steam hammer; and slides, chutes, and storage bins -- these were also the components of the last Quincy rockhouse built in 1908. The tools of the rockhouse remained basically the same; it was the <u>arrangement</u> of the hardware that would undergo numerous changes, and these changes were always directed at the same goals: to increase the rock-handling and storage capacities of the rockhouse; or to reduce the number of times laborers had to handle the rock, thus reducing the number of laborers required.

Quincy encountered some small problems in starting up its first rockhouse. First, its "automatic road" or tramway balked, and then the crushers failed when some castings fractured.[54] Once the crushers were beefed up, the rockhouse worked smoothly. On November 12, 1873, A. J. Corey wrote Horatio Bigelow that "the new rock house is in full blast and works like a charm." In the same month he boasted that an 1800 pound mass of copper had been hoisted, cleaned and shipped in a single day, and that with the old calcining method, it would have taken about a month.[55] In the 1873 Annual Report Corey noted that "the rock house is large and conveniently arranged, enabling us to handle with dispatch, all the rock we can hoist, and at much less cost than by the old method of calcining, and breaking by hand."[56]

The cost reduction was substantial. In 1871, the mine sorted and handled 60,072 tons of rock on the surface (only 38,328 tons of which needed calcining) at a cost of $24,809, or $.41 per ton. In 1872, the last year in which kiln houses operated alone, 60,628 tons were handled (only 38,058 were calcined) for $29,399, or $.48 per ton. In 1873, using its kiln houses and its new rockhouse, Quincy treated 64,220 tons of rock at a cost of $29,213, or $.45 per ton. In 1874 and 1875, using the rockhouse alone, Quincy handled 67,112 and then 71,441 tons of rock. The costs, respectively, were $25,218 and $21,495, or $.37 and $.30 per ton. The rockhouse's expenses for fuel and other supplies were greater than those of the kiln houses, but its labor costs were far less. In 1872, all kiln-house labor amounted to $26,735; in 1874, rockhouse labor, including engineers, brakemen, machinists, et. al., amounted to $16,450.[57]

The rockhouse apparently offered another advantage, besides a cost reduction. With calcining, the laborers reduced the rock to many irregular sizes and shapes. The mechanical crushers broke rock "to a smaller and uniform size." The importance of this change was felt at the stamp mill. The uniformity of machine-broken rock allowed Quincy to run its stamp mill machines "at a higher rate of speed," thus increasing the mill's capacity.[58]

Quincy's rockhouse handled all the products of shafts 2 and 4 until the last day of 1879, when fire destroyed it. Quincy's President called the loss the "most serious misfortune that has ever befallen us, involving the expenditure of a large sum in rebuilding, and causing some delay in the production of mineral."[59] The replacement rockhouse, patterned after the first and built on the same spot, was started up on March 10, 1880.[60] That structure survived until June 7, 1887, when lightning struck and Quincy lost its second rockhouse to fire.[61]

By mid-November 1887, Quincy had a new tramroad leading to its third rockhouse, which was quite different in appearance from the first two (see HAER photocopies of historic photographs), and located several hundred feet closer to shafts 2 and 4. The internal changes made to these rockhouses -- particularly those introduced as the structures were rebuilt -- unfortunately cannot be documented in great detail. But small changes and adjustments seem to have occurred with some frequency. In 1884, for example, Quincy adjusted the grizzlies for screening rock at least three times, until 14 men (8 on the day shift, 6 at night) were able to do the work which previously required 22.[62] In 1889-1890, a small addition was made to the rockhouse, as S. B. Harris reintroduced a steam hammer for cleaning barrel work.[63]

Change at Quincy from the early 1870s to the early 1890s was by no means limited to the adoption of air drills, high explosives and rockcrushers. Other changes bear noting, starting with those which occurred underground and then moving to those on the surface.

Three years after Quincy tried its first Burleigh air drills, it introduced another kind of drill. Until this time, underground prospecting had taken the form of adits or cross-cuts. Miners drove 6" x 5" tunnels perpendicular to lodes on the Quincy property to test their whereabouts and breadth. The tunnels were expensive. No specific figures for exploratory cross-cuts are available, but in 1875 it cost Quincy $14 per foot to drive drifts of comparable size.[64] To lessen the expense of exploring, in that year Quincy acquired its first diamond drill.

The machine was a Leschott, purchased for $1,500.[65] The diamond-tipped bit, which revolved as it was fed forward, had a hollow center and took a core sample of the rock it passed through. By examining the sample, the Mining Captain could determine when the bit entered and left copper-bearing rock.

Quincy acquired its machine in September and in November began paying to "Diamond drill runners" $55 per month to operate it.[66] In the first month, the Leschott drilled a total of 261 feet, and in its first year it passed through 151 to 452 feet of rock per month.[67] Quincy drilled most of its holes horizontally -- from a drift into the hanging or foot wall -- to prospect for parallel lodes.[68] All core samples were inspected, and the course of each hole was mapped to form a permanent record. In writing of the drill's first few months of use, the Mine Agent, in the 1875 Annual Report, stated that, "Although we cannot record any brilliant discoveries from its use, it has solved many doubtful problems at small cost, and more than saved the price of the drill in the prevention of useless cross-cuts."[69]

While Quincy appreciated the value of diamond drilling, it was not satisfied with the performance of the Leschott machine. In August 1877, it purchased a different drill and 200 feet of drill rod from M. C. Bullock for $2,500.[70] The drill exceeded Bullock's guarantee of "twenty-five percent increase of duty" over the first drill, and at less cost. Using the Bullock, a wide, valuable lode was quickly found near the No. 2 shaft after the drill passed through only three feet of trap rock.[71]

The diamond drill by no means found copper wherever it was pointed. But even when the cores contained nothing but poor rock, they were beneficial, as reported in the 1878 Annual Report:

> The diamond drill has been kept actively employed; its principal work being confined to a thorough exploitation of the two hundred and forty, two hundred and fifty, and two hundred and sixty fathom levels. No extensive mineral deposits were discovered; but much valuable information has been obtained, and, by no means, could so many explorations have been made at so small a cost.[72]

From 1875 onward, the Annual Report usually recorded the extent of diamond drilling for the year. In 1889, Quincy bought another new Bullock drill, a "Little Champion,"[73] and by the end of 1894 the mine had drilled 534 holes, whose length totalled 51,510 feet.[74] Later in the 20th century, a review of the Lake Superior mines noted that Quincy, more than any other, relied on the diamond drill for exploring known lodes.[75]

Quincy used the diamond drill to help find copper rock and turned to air drills and high explosives to free it. But there was little change in the general manner of exploiting the lode. Quincy still operated under the advancing system. Drifters pushed away from the shaft, as did the stopers who followed. The mine's walls remained strong and sound, so timbering was little-used and stone pillars were generally deemed unnecessary. At some point in the 1880s, Quincy did make one change in its manner of developing new ground. The early levels had been only 60 feet apart. To reduce the number of drifts and the costs of development work, Quincy increased the distance between levels to about 100 feet.

As it descended, the Pewabic Lode's "dip" flattened out. After starting into the ground at an angle of 54 degrees, the lode moved closer to the horizontal; by the time Quincy closed in 1931, the dip had decreased to some 34 degrees. So as the mine moved deeper, the stopes became less steep. Eventually Quincy resorted to mechanical means of pulling rock down to the bottom of overhand stopes, but throughout this period the stopes were sufficiently inclined to allow for a reliance on gravity. Yet mucking out the stopes and tramming remained labor intensive activities. The cars were all loaded and pushed by hand. Their contents were still dumped directly into skips.

For the first time the mine was not ventilated solely by natural drafts. Mechanical means were installed in a few particularly close drifts and stopes,[76] and the exhaust from air drills also helped freshen the atmosphere. The mine was still dimly lighted. Miners continued to work by candlelight, but after 1873-1874 many, if not all, of the tapers were fashioned from stearine, instead of tallow. By 1879 telephone lines connected Quincy's dock, mill, mine office, store and supply office -- and a line ran down the No. 4 shaft to the 240-fathom level. This certainly represented the very early use of the telephone by a mining company, yet the telephone was more a convenience than any kind of communications "revolution," and its use did not extend to all possible cases. The fillers, landers, and engineers at shafts 2 and 4 were not connected by telephone; they continued to use pull-ropes and bells. The mine extended and improved the man-engine numerous times, and it continued as the basic means of moving men up and down. Rock hoisting, on the other hand, changed considerably. Quincy made many minor and some major changes in hoisting from 1870 to 1892, and it carried on maintenance and repair operations which were often extensive.

The rock-skips kept their box-like shapes and general configuration. By 1884 Quincy sided its skips with steel, instead of wrought iron, and the company had increased their capacity to three tons.[79] By this date, Quincy had also introduced some underground skip dumps in shafts 2 and 4. The company no longer had to hoist all waste rock to the surface that had to be gotten out of the way.[80] Quincy now deposited part of it in stoped out areas in the mine's upper levels. Because runaway skips had sometimes damaged the shaft compartments, in 1889 Quincy applied flanges or guides over the rails to restrict the skips' motion, even if their wheels had jumped the tracks.[81] Quincy continued to hoist its skips with round wire rope, about $1\text{-}^{1}/_{4}$" in diameter and usually supplied by Roebling. Like most Lake Superior mines, Quincy never experimented with flat rope and reel-type winding devices.

Quincy regularly extended the skip roads to reach the bottom of the mine and occasionally it relaid track sections. In 1873, for example, Quincy put down a new road into No. 2, from the 90 to the 140 fathom level, and it replaced the track in No. 4, using wrought-iron T-rails weighing 25 pounds per yard.[82] By 1888 Quincy had replaced all the wrought-iron rails in both shafts with new steel ones.[83] At that time, each shaft still carried but one skip road, traversed by a single 3-ton skip. These skips, working two shifts, were sufficient to hoist all the rock that Quincy could handle on the surface. In particular, they kept the stamp mill on Portage Lake operating at full capacity. There was no need to substantially increase the hoisting capacity until Quincy augmented its milling facilities. By 1883 a new mill was at least foreseeable, and Quincy enlarged and modified the No. 2 shaft so that in the future a second track and skip could be installed.[84]

With only one skip per shaft, no productive work was achieved while the empty skip was returned to the mine. With two parallel skip roads, one loaded skip could move up while the other moved down. This could be accomplished by having both hoisting ropes attached to opposite ends of the same drum -- with one rope passing over and one under the drum -- or by installing a second winding drum. Besides nearly doubling hoisting capacity, this method of hoisting "in balance" would save energy. The weight of the descending skip and its rope would help pull the other skip up. The engine would consume less fuel because it had to provide less power.

Quincy started constructing a new stamp mill on Torch Lake in 1888, and this facility, which used steam-stamps, rather than gravity stamps, opened in 1890 and relieved a bottleneck that had limited Quincy's annual production of ingot copper to some 6 million pounds since 1881. In 1889 Quincy began preparing No. 4 for a double skip-road, and in August 1890 it introduced balanced hoisting at No. 4.[85] The No. 2 shaft followed suit in January, 1891:

> The arrangement for these balanced skips not only material cheapens the cost of hoisting, but will enable us from this time forward to about double the output of rock handled in former years.[86]

On the surface, each shaft-house was altered to receive a second skip road, and an additional dump was added to both No. 2 and No. 4. Still, these structures remained relatively simple, wooden-framed affairs. The No. 4 shaft-house had been rebuilt in 1877, and moved some 11 feet south at the time, when the top portion of the No. 4 shaft was straightened to remove a crook above the 40-fathom level. The No. 2 shaft-house had been rebuilt in 1881.[87] The structures still contained facilities only for receiving and dumping rock. All sorting and breaking operations took place in the rockhouse.

Quincy's hoist plants, at shafts 2 and 4, underwent considerable change between 1870 and 1890, and yet the changes were not nearly as far reaching as they might have been. Prior to the 1890s, Quincy -- instead of buying new equipment — concentrated on squeezing every bit of usefulness from engines already on hand. The upright Hodge and Christie engine that Quincy traded for in 1867 served the No. 2 shaft until 1894. As the mine got deeper, Quincy periodically "lagged" (built up the diameter) of its winding drum or replaced it with a larger one, so that a longer rope could be carried. In 1873, for example, Quincy mechanics replaced the No. 2 drum, and they also overhauled and strengthened the No. 2 engine when they discovered a serious crack in its bed plate.[88]

Quincy's original hoists and their houses sat between shafts, where they could serve more than one. By the 1880s, the wooden hoist houses were delapidated, and with only two shafts operating, there was no reason to maintain their original position. In 1882 Quincy erected a new stone engine house on the east side of the No. 2 shaft.[89] (In the 1880s and 1890s Quincy systematically built of stone or brick, rather than wood, to reduce the fire risk.) The company then rehabilitated the old hoist house to serve as a much-needed machine shop.

Quincy moved the Hodge and Christie engine into the new hoist house and installed a new friction gear and drum. The cylindrical drum, 14 feet in diameter and having a 17-foot face, could carry 4,000 feet of 1-$^1/_2$ inch rope, making it one of the largest drums in the region.[90] The new hoist house was laid out in a manner which allowed a second drum to be added, in 1890-1891, when the mine resorted to balanced hoisting. The engine was never made direct-acting; power was transmitted to the drum via a "V" friction gear until 1891, when a new toothed gear was installed.[91]

The J. B. Wayne & Co. hoist installed at No. 4 in 1862 received a new boiler and winding drum in 1870. The engine could not handle the new load; the mine agent noted in the 1871 Annual Report that, "We need a new hoisting engine of greater capacity for the No. 4 shaft."[92]

In December 1872 Quincy mechanics installed a new engine provided by Jackson & Wiley, "Founders and Machinists," at a cost of $8,000.[93] The engine had a 26" bore and a 5-foot stroke. To further demonstrate its frugal stance towards engines, Quincy took the old No. 4 hoist engine and set it up to run the mine pump and man-engine; it took the old engine from the pump and put it in the new rockhouse to run the breakers.[94]

The Jackson & Wiley engine installed at No. 4 in 1871 continued to operate until 1909, when that shaft finally closed. In 1884 Agent S. B. Harris contemplated a replacement, largely because of recommendations made by Nathan Daniels, Quincy's Transfer Agent and unofficial steam expert. The Jackson & Wiley horizontal engine drove a 12-foot diameter drum with a 12-foot face. The engine had a common slide valve set to cut-off at three-quarter stroke. Running on 55 to 60 pounds of steam, the engine turned 50 r.p.m.[95] In January 1884, Daniels wrote Harris to complain of the "delapidated condition of the hoisting apparatus" at No. 4.[96] "You want," he wrote, "a modern engine with a variable cut off and dispense with the old slide valve you now have -- and new Drum and all that goes with it."

Over the next half year, Daniels continued to press for a new engine. In May he noted:

> The power required at the shafts and the stamp mill is large, and the engines at each place, would not in our Eastern mills be allowed to remain in place longer than the time required to replace them with others of modern construction.[97]

"Modern construction," for Daniels, meant an engine with Corliss valves and a variable cut off. Harris argued that "the old is equal to the requirements for years to come." Daniels agreed that the Jackson

& Wiley engine at No. 4 was "big" enough, but size was not the issue:

> The real question is not whether the old slide valve Engine now there is big enough or can be built over and made big enough to do the work at that shaft for some years, but rather can the corporation afford to literally throw away the extra fuel required to furnish steam, and hold on to an old-fashioned engine, entirely behind the requirements or economics of the present age. It is a simple question of dollars and cents and so becomes directly of interest to stockholders that their servants shall be fully alive and up to the present date in all matters.[98]

Daniels shopped around for a new engine at No. 4 and found a variable cut-off engine that could be had for $6,900; he also suggested that the mine investigate the Reynolds-Corliss engines built by the E. P. Allis Company.[99] S. B. Harris, however, finally decided to postpone any decision of a new engine; the old one could limp along for another year or two.[100] That year or two stretched out for 25 years.

In 1885-1886 Quincy built a new stone hoist house east of the No. 4 shaft for the old engine. A new 60-ton cylindrical drum was installed, 18 feet in diameter and 8.5 feet across the face.[101] Now both the No. 2 and No. 4 hoists could operate to a depth of 4,000 feet. The drum had two brake bands and a new driving gear as well. The main shaft of this gear was extended, so a second engine could be attached in the future. Daniels had wanted a hoist plant of thoroughly "modern construction." Harris settled for one that was "plain, strong, easily operated and durable."[102]

The No. 4 hoist was modified to accept double skips in 1890, and the gearing changed to increase the speed of ascending skips by 25 percent. Harris anticipated that the unit could now hoist 500 to 600 tons per day. In 1895, mechanics enlarged the drum's diameter from 18 to 22 feet, thereby increasing its operating depth by 600 feet.[103] At the same time, Quincy enlarged the engine house and added a second engine to help drive the drum. It, too, was hardly of "modern construction." The 32" x 60" engine had been used for many years at the old stamp mill on Portage Lake.[104]

Prior to 1890, largely to avoid the expense of new equipment, Quincy chose not to purchase more efficient steam hoists. The company relied on old slide valve engines, rather than new ones with variable cut-off valves. The newer valves conserved fuel by automatically closing as early as possible into the piston's stroke, and by using the expansive nature of steam to better advantage. In other ways, however, Quincy paid more attention to its energy consumption and generation.

Quincy in the late 1850s and 1860s had had few engines and therefore relatively small energy needs. To meet these needs, disparate boiler plants were distributed across the mine site; the boilers were located where the engines were. Each hoist, for example, had its own steam plant. As the mine increased in depth, the hoisting engines were enlarged, requiring more steam, so periodically more boilers were added. The addition of other new machinery -- principally rock-crushers and air compressors -- also necessitated a substantial increase in fuel consumption and steam generation.

In the 1881 Annual Report, the agent wrote that:

> No time should be lost in giving our steam equipment full consideration. Quite a number of our boilers have been in use over twenty years, and all are old, and require frequent repairs, involving us in great liability to accident, as well as, under great circumstances, being far from economical.[105]

A lack of steam, the danger of explosion and fire, and the inefficiency of old, disparate steam plants prompted Quincy to build a more central facility east of the No. 4 shaft in 1882.[106] The company built a stone structure to house eight new tubular boilers and all the necessary feed-water pumps and connections. This single plant provided steam -- through cast-iron pipes laid in trenches — to both the No. 2 and No. 4 hoists, to the mine pump, the machine shop, and the air compressors.

Maintaining sufficient boiler capacity was one problem; maintaining an adequate supply of boiler feed water was another. Sitting on the plateau almost 600 feet above Portage Lake, Quincy was not always endowed with an abundance of water for steam generation. During some winters it even had to resort to melting snow to augment the water collected and stored in cisterns near the boiler plants, cisterns that provided feed-water for boilers, and in emergencies, water for fire-fighting.[107] Starting in 1872, Quincy pumped water from its abandoned shafts on the Quincy Lode to its cisterns.[108] This arrangement did not work as well as had been hoped; perhaps too little water was available. In 1881 the company constructed works at the mill on Portage Lake to pump water four-fifths of a mile to the mine plant.[109] Quincy continued to rely on Portage Lake water until the mine closed.

Quincy changed its source of water; it also changed its fuel. Originally, wood harvested near the mine fired all of Quincy's boilers. In 1862, "to provide against the gradually increasing costs of timber and fuel," the company had purchased surface rights to Sections 15 and 22, adjoining the mine, which it used for woodlots.[110] Instead of hiring its own laborers to cut wood and transport it to the mine, Quincy apparently contracted for this service. Quincy's woodlots provided the mine with fuel for over twenty years. By 1884-1885, they still contained a substantial amount of timber, yet the mine was considering a switch to coal.

It is not clear whether company officers in New York or the mine agent in Hancock instigated the change. Early in 1885, S. B. Harris, in a letter to Thomas F. Mason, noted that the change to coal, if made, should be complete. The mine's boilers could be arranged to burn either coal or wood efficiently, but not both. Harris opined that it would be better to use "wood all the time, or coal all the time." Since the woodlots were not depleted, it seemed wiser to Harris to "use up most of our wood first and then turn to coal."[111]

Harris' viewpoint did not prevail. The move to coal was made over several years, starting perhaps in 1886, when the Mineral Range Railroad Company built a branch line to Quincy's central boiler house near the No. 4 shaft.[112] This line made it more convenient to transport coal or other freight to the mine.

There was no local source of coal; freighters had to carry it north from ports on the lower Great Lakes. When wood was used, Quincy was dependent on itself for fuel. When it switched to coal, Quincy became dependent on far away coal mines, brokers and shippers. The mine sometimes had problems getting just the coal it wanted -- and when it wanted it. These problems were exacerbated by the environment. Each winter closed the shipping channels, so by November Quincy needed a stockpile sufficient to carry it through till March or April. There is no evidence that Quincy ever failed to gather an adequate supply, but in more than one year it cut it close, securing coal on some of the last lake freighters of the season.

Coal, like blasting powder, sometimes spurred controversy between the Michigan and New York ends of the company. In 1887, S. B. Harris experimented with at least three kinds of coal: "Youghiogheny," "Jumbo," and "Mansfield." Mansfield proved superior and Harris deemed it 20 percent more efficient.[113] For the next several years, the mine used both Mansfield coal and wood. (It is possible that the central boiler used coal exclusively, and that wood fired the smaller, separate boilers that still remained, such as the ones in the rock-house.) Quincy, according to Harris, was not alone in its preference for Mansfield. In 1891, when Quincy used cord wood, slabs, and coal equivalent to 26,500 tons of coal, Harris wrote William Rogers Todd that all large coal consumers in the area favored Mansfield.[114] He noted this in responding to the fact that the New York officers had recently ordered a shipment of "ocean mine" coal.

The New York officers, as in earlier instances involving blasting powders, sometimes felt that the mine bosses in Michigan were too complacent, too ready to stick with a "tried and true" material instead of shopping around for something better, or cheaper. The officers saw it as their fiscal duty to help make wise choices when selecting those supplies which were consumed in large quantities. But whenever the New Yorkers made an autonomous choice, and presented it to the Agent as a fait accompli, they were sure to ruffle his feathers. And the officers, as in the case of ordering "ocean mine" coal, did not always announce their choices in a very diplomatic fashion:

> We have carefully considered this matter, and have concluded, that the best result is obtained from the "ocean mine" coal, that we have ordered. Large consumers, people we have talked with, say if the coal does not prove entirely satisfactory, the defect must be, from want of proper attention in firing. Although not equal (to) other coal, "Mansfield" sometimes has the preference with many as it needs less care on the firemen's part.[115]

In short, W. R. Todd said that ocean mine coal was a superior fuel. If Harris and his boilermen did not recognize that fact, it was because they were too unskilled or too lazy to tend the coal properly in Quincy's boilers. Harris remained unconvinced. A year later, in 1892, he wrote W. R. Todd that, "The best coal ever used here is the so-called "Mansfield," 1-1/4 inch screen. . . ."[116] Mansfield, because of the recalcitrant agent, continued to prevail, at least through the 1890s, even though the New York officers apparently tried more than once to effect a change in fuel.

The period c. 1870 to 1892 saw substantial changes in the technologies employed at Quincy and considerable growth in terms of product, and all the years were profitable ones. The most significant changes were the successful introductions of Rand air drills and high explosives (1878-1881); rock-crushers (1873); and balanced hoisting (1890-1891). Yet while it effected significant changes in these areas, Quincy stood pat in others, principally the mucking out of stopes and the tramming of rock to the shafts: These remained highly labor intensive, non-mechanized operations.

The mine was undeniably successful, but its potential was still unfulfilled. Quincy's growth -- despite the 1881 jump from roughly 3.5 to 6 million pounds of copper per year -- had been held in check by two key factors: by the stamp mill and by property lines. Quincy clung to its gravity or drop stamps within its Portage Lake mill long after comparable mines in the district had adopted steam stamps.[117] Quincy claimed that the drop stamps allowed them to capture more copper per ton of rock stamped, and that they were at least as economical as the more powerful steam stamps. Both claims may have been true. Nevertheless, the steam stamps could handle a far greater tonnage of rock. In other words, with steam stamps the percent yield of copper per ton might drop, but a far greater tonnage could be processed.

Part of Quincy's 1881 production jump was attributable to fortunate circumstance: the discovery of pockets exceedingly rich in mass, barrel and stamp copper. The mine could not count on the continuance of such pockets. To further boost production, it finally had to divest itself of the old Portage Lake mill. Once the new Torch Lake mill was in place, armed in 1890 with three steam stamps, Quincy pushed for greater production from shafts 2 and 4, and raised enough more rock with its balanced hoists to jump to 8 million pounds of ingot in 1890; 10.5 million pounds in 1891; and 11.1 million pounds in 1892.[118]

By taking advantage of the growth potential at the new mill site, Quincy could also relieve the second important impediment to its growth: its property lines. The mine had sustained and expanded its production over 20 years solely by going down deeper with shafts

2 and 4. It had discovered no new lodes on its property, and it was limited to exploiting only a short length of the Pewabic. To the south, Quincy still confronted faulty ground. To the north, Quincy confronted its boundary with the Pewabic Mine.

In the 1880s, Quincy had been biding its time, waiting for the Pewabic Mining Company to finally fail. Pewabic had been very unlucky. It found the Pewabic Lode, which Quincy worked on the south and the Franklin Mine worked on the north. Of these three companies -- Franklin, Pewabic and Quincy -- the mine which discovered the lode was the one most poorly situated over the copper. The lode cut across only one corner of Pewabic's section. So Pewabic had been hemmed in and doomed. After much hassle and after an exploratory trespass or two (drifts carried beyond Quincy's boundary to open up and explore Pewabic's grounds), Quincy finally obtained full legal rights to the Pewabic lands in 1891. Now it had room for another shaft that would start on Pewabic ground, pass under a Quincy-Pewabic boundary, and open up a large block of Quincy ground that previously had been inaccessible.

Quincy had been productive throughout the 1870 to 1890 period. With two new acquisitions -- the steam-stamp mill on Torch Lake and the Pewabic property -- Quincy was poised for a take-off in 1891. The mine's most active growth period -- when it greatly upgraded its surface plant and extended its underground works -- was to come in the next ten years.

NOTES -- CHAPTER II

1 Copper production figures are taken from QMCo Annual Reports.

2 QMCo 1871 Annual Report, p. 18.

3 Ibid., p. 7.

4 QMCo 1873 Annual Report, p. 8.

5 QMCo 1872 Annual Report, p. 21.

6 Ibid., p. 16.

7 Invoice, July 15, 1872, QMCp Invoice Book, 1864-1873.

8 A. J. Corey to Rogers Todd, Nov. 11, 1872. Corey wrote: "We have not been able to handle them rapidly enough to effect much saving as yet, but the men handling them are improving fast and this month we hope to show good results."

9 Corey to Burleigh Rock Drill Co., Dec. 7, 1872.

10 Corey to Rogers Todd, Jan. 7, 1873. Besides trying to increase the drills' output by moving to larger drifts, Quincy also seems to have experimented at this time with electrical detonation of powder charges. The 10' x 10' were pushed a little more rapidly "by the aid of batteries." In a letter to G. E. Lincoln & Co. (Dec. 20, 1872), Corey noted that the specially ordered "batteries" and "fuses" seemed to work satisfactorily. Also, an invoice dated Jan. 4, 1879, about the time Quincy was trying the Rand drills, lists "1 Electro Magneto Battery" at $25.

11 Corey to Rogers Todd, Jan. 7, 1873.

12 Corey to Burleigh Rock Drill Co., Nov. 16 and Dec. 7, 1872. In his December letter, Corey wrote that "our need is short drills to push our small opennings ahead rapidly." He wanted them to carry one-inch steel and noted that the drills need not be as powerful as the first ones, or carry self-feeding mechanisms.

13 Corey to Rogers Todd, March 3, April 10 and July 2, 1873.

14
Invoices, June 14 and August 13, 1873, QMCo Invoice Book, 1873-1877; AMCo 1873 Annual Report, p. 15; Corey to Wm. R. Todd, Sept. 5 and 11, 1873.

15
QMCo 1873 Annual Report, p. 20.

16
QMCo Contract Book, 1878-1881, p. 166. The early purchases of Rand drills are documented in QMCo Invoice Book, 1877-1882, entries for June 28, 1879; June 11, 1880; August 25, Sept. 7 and Oct. 18, 1881; and July 11 and Oct. 5, 1882.

17
QMCo Contract Book, 1878-1881, pp. 160, 165, 178.

18
QMCo 1880 Annual Report, p. 3.

19
Invoice, C. H. Delamater, June 12, 1872, in QMCo Invoice Book, 1864-1873. Delamater is believed to have been a New York City foundry. Quincy occasionally referred to this machine as the old "German" compressor.

20
Rand Drill Company to QMCo, "Proposal," July 11, 1881; QMCo 1881 Annual Report, p. 7; invoice, Sept. 29, 1881, QMCo Invoice Book, 1877-1882.

21
QMCo 1884 Annual Report, p. 12; S.B. Harris to Thos. Mason, Jan. 18 and 31, 1884. The old Delamater compressor was also a duplex, having a 17" x 50" bore and stroke; it ran at 20 strokes per minute. The Rand Duplex, 16" x 30", ran at 60 rpm.

22
Numerous reports, John Cliff to S. B. Harris, QMCo Letter File, 1888-1889.

23
Rand drill contracts are found in QMCo Contract Books covering these years. All Rand drill contracts in the late 1880s were for four operators -- two to work each shift.

24
QMCo 1879 Annual Report, p. 3.

25
Corey to Wm. R. Todd, Feb. 15, 1874.

26
Corey to Austin, April 1, 1874.

27
Corey to Wm. R. Todd, April 21, 1874.

28
Invoice, Aug. 19, 1878, QMCo Invoice Book, 1878-1879.

29
Invoice, Aug. 31, 1878, QMCo Invoice Book, 1878-1879.

30
Calculated by summing the invoices dated 1880 for these materials in QMCo Invoice Book, 1879-1881.

31
Invoices, August 17 and 18, Sept. 19, Oct. 19, Nov. 30 and Dec. 31, 1881, in QMCo Invoice Book, 1881-1882; plus numerous other entries in this volume.

32
S. B. Harris to Thos. F. Mason, Feb. 16, 1884.

33
Ibid.

34
Corey to Wm R. Todd, Feb. 15, 1874.

35
S. B. Harris to N. Daniels, July 1, 1884.

36
S. B. Harris to N. Daniels, Aug. 24, 1884.

37
Production and employment figures drawn from QMCo Annual Reports.

38 ?

39
QMCo 1877 Annual Report, p. 15.

40
QMCo 1880 Annual Report, n. p.

41
Nathan Daniels to S. B. Harris, Jan. 28, 1884.

42
QMCo, 1877 Annual Report, p. 15.

43 ?

44
S. B. Harris to Thos. F. Mason, Oct. 4, 1884.

45
QMCo 1863 Annual Report, p. 14.

46
QMCo 1864 Annual Report, p. 13.

47
QMCo 1871 Annual Report, p. 18.

48
QMCo 1872 Annual Report, p. 16; 1873 Annual Report, p. 15.

49
Blake Crusher Co. invoice, Jan. 16, 1873 in QMCo Invoice Took, 1864-1873; A. J. Corey to Blake Crusher Co., Jan 23, 1873; QMCo 1873 Annual Report, p. 21.

50
A 2296 lb. hammer shows on a Portage Lake Foundry and Machine Shop invoice, March 1, 1873, QMCo Invoice Book, 1872-1874.

51
Corey to H. Bigelow, Oct. 6, 1873. This letter specifically mentions a "steam hammer" and notes that it cost twice as much as the drop hammer. Later references, however, make no mention of it.

52
The Portage Lake Foundry invoice of March 1, 1873 lists 14 grate bars and a total of 8 slides.

53
QMCo Time and Day Book, 1873-1877, entries for Jan., 1874.

54
Corey to H. Bigelow, Oct. 6 and Oct. 25, 1873. The Portage Lake Foundry apparently had to make new, heavier castings for some of the rock breakers. (Invoice, May 1, 1873, QMCo Invoice Book, 1872-1874.)

55
Corey to Wm. R. Todd, Nov. 4, 1873.

56
QMCo 1873 Annual Report, p. 21.

57
All data taken from QMCo Annual Reports, 1871-1875.

58
QMCo 1874 Annual Report, p. 16.

59
QMCo 1879 Annual Report, p. 3.

60
QMCo 1880 Annual Report, p. 3.

61
QMCo 1887 Annual Report, pp. 11-12.

62
S. B. Harris to Thos. F. Mason, Feb. 23 and May 16, 1884; Harris to N. Daniels, Aug. 24 and Oct. 6, 1884.

63
S. B. Harris to T. F. Mason, Dec. 7, 1889, Feb. 4 and May 1, 1890; QMCo 1890 Annual Report, p. 12.

64
QMCp 1875 Annual Report, p.

65
QMCo 1875 Annual Report, pp. 14, 21.

66
QMCo, Engineer's Time and Day Book, 1873-1877.

67
Ibid.

68
S. B. Harris to W. R. Todd, Jan. 11, 1900.

69
QMCo, 1875 Annual Report, p. 21.

70
M. C. Bullock invoice, Aug. 21, 1877, QMCo Invoice Book, 1873-1877; QMCo 1876 Annual Report, pp. 14, 20.

71
QMCo 1877 Annual Report, p. 18.

72
QMCo 1878 Annual Report, p. 4.

73
M. C. Bullock to S. B. Harris, Mar. 19 and Aug. 13, 1889. In the second letter Bullock requests that Quincy return the first "Little Champion" drill it had bought in 1877. He implies that Quincy's drill was one of the early Bullock machines to be sold, and he wants it returned as a keepsake.

74
QMCo 1894 Annual Report, p. 14.

75
USGS, Prof. Paper 144, p. 153.

76
Corey to Wm. R. Todd, Sept. 5, 1873.

77
Corey to Mssrs. Leopold and Austrian, Sept. 25, 1873; Corey to French & Co., Sept 26, 1873. In the first letter Corey proposes "trying" stearine candles, and in the second he discusses a purchase of 15 tons of stearine. The QMCo Invoice Book, 1876-1878, records a total of 19,655 pounds of candles purchased in 1876 and 42,856 pounds in 1877.

78
QMCo 1879 Annual Report, p. 3.

79
S. B. Harris to N. Daniels, Jan. 22, 1884; Harris to W. R. Todd, May 8, 1884.

80
QMCo 1883 Annual Report, p. 12; "During the past year we have placed dumps in each shaft at the several points where feasible to reach worked out stopes, and so far as practicable the waste or poor rock has been dumped into those open places. . . ."

81
John Cliff to S. B. Harris, June 3, 1889.

82
QMCo 1873 Annual Report, p. 20; Corey to R. Todd, Feb. 18, 1873.

83
John Cliff to S. B. Harris, June 2, 1888.

84
QMCo 1883 Annual Report, p. 12.

85
S. B. Harris to T. F. Mason, Oct. 24, 1889, June 16 and Aug. 9, 1890; Harris to W. R. Todd, July 3, 1890; QMCo 1889 Annual Report, p. 11.

86
QMCo 1890 Annual Report, p. 11.

87
QMCo 1876 Annual Report, p. 20; 1877 Annual Report, p. 14; 1881 Annual Report, p. 7.

88
Corey to R. Todd, March 12, 1873; QMCo 1873 Annual Report, p. 20.

89
QMCo 1882 Annual Report, p. 12.

90
Weekly Mining Journal, July 21, 1883, p. 4. This article speaks of a "new hoisting engine and drum" at No. 2, but all other references suggest that only the drum was new.

91
S. B. Harris to W. R. Todd, Feb. 14, 1891; Harris to T. F. Mason, Jan. 16, 1891.

92
QMCo 1870 Annual Report, p. 14; 1871 Annual Report, p. 18.

93
Jackson & Wiley invoice, June 29, 1872 in QMCo Invoice Book, 1864-1873; QMCo 1872 Annual Report, p. 16.

94
QMCo 1873 Annual Report, p. 20; Corey to W. R. Todd, April 10, 1873.

95
S. B. Harris to Fraser & Chalmers, April 10, 1884; N. Daniels to Harris, March 17, 1884.

96
Daniels to S. B. Harris, Jan 28, 1884.

97
Daniels to Harris, May 22, 1884.

98
Ibid.

99
Daniels to Harris, Mar. 17, 1884.

100
S. B. Harris to T. F. Mason, May 16, 1884.

101
QMCo 1885 Annual Report, p. 12.

102
S. B. Harris to Thos. F. Mason, Aug. 13, 1885.

103
S. B. Harris to Wm. R. Todd, Nov. 5, 1895.

104
S. B. Harris to Thos. F. Mason, Oct. 17, 1895; QMCo 1895 Annual Report, p. 14.

105
QMCo 1881 Annual Report, p. 12.

106
QMCo 1882 Annual Report, p. 11.

107
QMCo 1875 Annual Report, p. 22; 1881 Annual Report, pp. 7, 12.

108
QMCo 1872 Annual Report, p. 21.

109
QMCo 1881 Annual Report, p. 12.

110
QMCo 1862 Annual Report, n. p.

111
S. B. Harris to Thos. F. Mason, Jan. 19, 1885.

112
QMCo 1886 Annual Report, p. 12.
113
S. B. Harris to W. R. Todd, June 11, 1891.
114
S. B. Harris to W. R. Todd, April 5, 1892.
115
W. R. Todd to S. B. Harris, June 15, 1891.
116
S. B. Harris to W. R. Todd, April 5, 1892.
117
See Charles O'Connell's HAER report on Quincy Stamp Milling, 1978.
118
QMCo Annual Reports: 1890, p. ; 1891, p. ; 1892, p. .

CHAPTER III

The Copper Handbook, first published in 1900, served as a guide to investors by evaluating the status of copper mines throughout the United States. In its initial volume, the Handbook assessed Quincy in this manner:

> The Quincy Mine location is a very neat one, and the streets have the appearance of having been swept every morning. This tidiness appertains to the mine buildings and the millsite; there is a place for everything, and everything is in its place.

The Handbook also noted:

> In the way of new machinery and surface work the Quincy has made gigantic strides in the past three years, and in 1899 and 1900 the improvements have been on a truly colossal scale. The mine is literally being made over, on surface, in addition to the great changes in underground works.[1]

The evaluation was correct. By the turn of the century, Quincy was being "made over" and by 1903 its surface plant was "the most complete in the district, excepting Calumet and Hecla."[2] Only in its dating did the Handbook err. The "gigantic strides" did not start in the late 1890s, but in the first years of that decade, when Quincy committed itself to increasing production — when it opened its new stamp mill on Portage Lake; took over the Pewabic Mine; and acquired mineral rights to other ground northwest of the mine, an acquisition which allowed Quincy's shafts to go still deeper in that direction.

The Pewabic Mine had failed because it was hemmed in by its boundaries. Quincy's management, through land acquisitions, made sure that the same thing did not happen to them. Besides acquiring the Pewabic Mine in 1891, and mineral rights to land lying in the paths of Quincy's No. 2 and 4 shafts, the company moved further to the northeast along the Pewabic Lode. Although it had to jump over the still-operating Franklin Mine, Quincy purchased the next two over -- the old Mesnard and Pontiac Mines -- in 1896.[3] Where five separate companies had once stood along the Pewabic Lode, now there were only two, Quincy and Franklin, and Quincy's land purchases had hemmed in the smaller Franklin, throttling it and forcing a sale that finally occurred in 1909.

Shafts 2 and 4 were finally joined by others, as Quincy extended itself both to the north and the south. In 1892, Quincy began hoisting from its new No. 6 shaft (a rehabilitated shaft originally sunk by Pewabic) about 1900 feet north of No. 2. This was also known as the "North Quincy" shaft. In 1897, Quincy finally got back into its southern ground, starting work on a No. 7 shaft, 840 feet south of No. 4. Hoisting commenced there in 1900. In 1899, Quincy began to rework an old shaft abandoned by the Mesnard Mining Company, calling this shaft No. 8.

From the early 1870s to 1891, only shafts 2 and 4 were productive. By 1900, Quincy had five shafts: 2, 4, and 7 on its original property; No. 6 on the old Pewabic Mine site; and No. 8 at Mesnard. The distance from No. 7 on the south to No. 8 on the north was 7,500 feet. The mine indeed had made itself over. Quincy had vastly increased its underground works, as well as its surface facilities. Production jumped from 6.4 million pounds of ingot in 1889 to 16.3 million pounds in 1895 and to 20.5 million pounds in 1901.

Quincy took possession of the Pewabic on March 30, 1891, after a long legal dispute with the Franklin Mining Company, which also had designs on the property. Franklin, indeed, had been more closely associated with Pewabic over the years, and it had occupied the site for some time, using some of its facilities. Franklin had underground connections with the Pewabic works and used the old mine as a sump, as a source of water-supply. In 1891, Pewabic's physical plant was "in the most delapidated and ruinous condition imaginable."[4] Quincy acquired a host of mine structures there -- a blacksmith shop, two carpenter shops, a change house, powder house, two engine houses, a combination shaft- and rock-house, numerous other small mining structures, plus a considerable number of company houses. Many buildings dated from the 1860s, and much of the extant equipment was in poor repair or obsolete. Quincy rehabilitated several old structures, sometimes giving them a new use, and salvaged the best of the machinery. But it cleared other parts of the site away to make room for necessary improvements.

Quincy reconstructed Pewabic's No. 6 shaft to serve was its own No. 6. Pewabic had sunk it to the 34th level;[5] abandoned, its lower reaches had filled with water. Quincy had to unwater tbe shaft before it could straighten, enlarge and retimber it for a double skip road. Then, of course, Quincy would drive it to greater depths.

The work had hardly begun when, on April 8, 1891, a fire broke out in the shaft, somewhere below the tenth level, "burning the timbers, and causing the hanging rock to cave badly in places down as far as the water level."[6] The origins of this fire are mysterious. It may well have been accidental, but oddly enough, the new owners of the property suffered the least, while the greatest damage was inflicted upon the adjacent Franklin Mine. Quincy and Franklin had long been trying to out-maneuver one another to obtain the Pewabic, and relations between the companies were strained, if not hostile. The fire ran up and down an antiquated shaft that Quincy had to rebuild from top to bottom, anyway. And the fire struck before Quincy had invested much money at all in the reconstruction. In short, the fire did Quincy little harm.

To the north, however, the Franklin was a productive, operating mine that had driven drifts connecting with the Pewabic. (Quincy had done the same thing.) A little trespass for exploratory or other purposes was apparently not all that uncommon along the Pewabic Lode.[7] When No. 6 or "North Quincy" caught fire and filled with smoke, Quincy's connections to these works were sealed; Franklin's were not. The Franklin filled with smoke, became unworkable, and had to close down while Quincy waited for the fire to burn out. Today, it is impossible to prove that the fire was anything other than an accident, but Quincy was hardly distraught over the consequences.

Quincy had always been quite cautious in making expensive capital improvements to its physical plant. When bringing something new to the mine, such as air drills and compressors, it tended to start out small, test the operation, and then enlarge it only if successful. It had also "made-do" with extant structures and equipment, milking them for every bit of utility before resorting to new construction or new machines. The company had been frugal;

it had avoided all frills. Consequently, in 1890, its surface plant was serviceable, but none too impressive. But all this changed, beginning at No. 6. Quincy substantially raised its standards and put on more of the trappings of a successful and growing company. The key structures at No. 6 were a combination shaft-rockhouse, a hoist house, and boiler and compressor works -- all bound together and serviced by utility trenches carrying steam and air lines, and by a web of railroad sidings.

The No. 6 shaft was far removed from the rockhouse on the southern end of the mine, and the yield from the new shaft could not be handled there. Because the existing rock crushers did not have the capacity to break any more rock than that produced by shafts 2 and 4, Quincy augmented its rock-crushing system and at the same time made it more efficient. It eliminated some materials handling problems by moving its new complement of rock breakers right into the No. 6 shaft-house, thus creating a combination "shaft-rockhouse." Quincy was not the first to do this; several other Lake Superior mines had made the combination earlier. From 1891-1892 onward, however, Quincy never again lagged in developing and installing new and more efficient means of arranging rock-crushing machinery at its shafts.

Under the old system, rock hoisted to the surface was dumped at the shaft-houses, presumably into bins, and from the bins into rock cars that were trammed southward to the rockhouse, where the rock was dumped again. The most obvious asset of the new shaft-rockhouse was that it obviated shipment to the rockhouse via a tramroad and reduced the number of times the rock had to be handled.

Quincy's No. 2 and 4 shaft-houses had changed little over time, because their relatively simple function had remained the same. The heavy-timbered structures, occasionally renewed because of deterioration, had gotten somewhat taller; their head sheaves had been realigned when the hoist-houses were moved; and the dumps and bins must have been altered when balanced hoisting began. But real changes came with the much broader, taller No. 6 shaft-rockhouse. With No. 6 -- and with each shaft-rockhouse built after it -- Quincy truly had an impressive, monumental structure. If the early shaft-houses had been pedestrian, the shaft-rockhouses were landmarks that visually dominated Quincy Hill. (See HAER drawings of the 1892 No. 6 shaft-rockhouse and the 1908 No. 2 structure.)

Quincy began the No. 6 shaft-rockhouse in 1891. To make room for it, and for the rail lines which would connect it with the rest of the mine and the Torch Lake stamp mill, Quincy removed 40,000 cubic yards of waste rock that Pewabic had accumulated.[8] About $3,000 worth of timber went into the structure, which was completed in 1892.[9] Unfortunately, as was the case with the original 1873 rockhouse, it is impossible to trace a precise flow of materials through this building, because the complete arrangement of chutes and bins is unknown. However, a HAER drawing shows the general arrangement of all major pieces of machinery.

The structure, like the earlier rockhouses, contained equipment for treating stamp rock, barrel work and mass copper. It was much taller than earlier shafthouses, because a greater height was required to allow gravity feeds, using chutes, to move the heavy, cumbersome materials to and from machines and bins. Within the structure considerable human labor was still involved, whenever rock had to be moved horizontally. Yet one type of motion was avoided entirely. Once material was dumped from a skip, it never moved up, only across or down.

The shaft-rockhouse was lighted electrically, but the motive power was steam.[10] A 14" x 36" engine, removed from the stamp mill, provided power that was transmitted up and across the structure by leather belts, pulleys, and shafts. The shafting drove five rock-crushers, including two 12" x 14" machines salvaged from an old Pewabic shaft-rockhouse. The third and fourth crushers, 13" x 20", were presumably of the Blake-type and supplied by the local Lake Superior Iron Works for a total of $1860. The same manufacturer may have supplied the fifth crusher, too, which was of a larger but otherwise unspecified size. The shaft-rockhouse also contained a $700 steam hammer manufactured by William Sellers in Philadelphia, and a heavy drop hammer produced locally in accordance with Quincy's own design.[11]

The No. 6 shaft, as noted, was double-tracked. Either skip could be hoisted to near the top of the shaft-rockhouse and dumped.[12] The rock fell from the skips onto cast iron grates (or grizzlies) raised only slightly from the horizontal. Because the grizzly carried only a slight downward slope, men had to tend it, to help rock move along it and free any jams. A later improvement would more sharply incline the grizzlies, to allow the slide to work more freely.

Rock small enough to pass the grizzly was small enough for the steam stamps at the mill, so it fell directly from the top of the structure into a bin. Material too large to pass through (rock larger than about 3 inches) was drawn out on an upper level floor, where men separated and moved it by hand. They threw the smaller pieces into one of the two small jaw crushers standing on either side of the grizzly; once past the crusher, this material fell into a storage bin. Workers threw the larger pieces into a nearby, bigger breaker. Reduced once in size, it passed down to one of two smaller breakers just below, and then into a storage bin. Mass copper was cleaned at the drop-hammer, and barrel work at the steam hammer. The storage bins for the various materials were elevated over railroad sidings that passed beneath or alongside the building. Rail cars were filled simply by opening chutes and letting gravity do the work.

The rock-handling system was still not perfected. Improvements were to come, principally to increase the sorting abilities of the grizzlies; to enlarge bin capacities so that scheduling rail service to unlode them became less critical; and to eliminate the manual labor involved in picking up rock and feeding it into small or large crushers. As mentioned earlier, the equipment in the 1892 shaft-rockhouse was not at all unlike the equipment to be installed in another shaft-rockhouse, sixteen years later. But Quincy would continue to rearrange the rockhouse's parts.

A line of pulley stands connected the No. 6 shaft-rockhouse with the new No. 6 hoist house. The earliest hoist houses had been wood; then in the 1880s Quincy had made them (at Nos. 2 and 4) of poor rock from the mine. The new No. 6 hoist house was a more attractive, finished structure with walls of Portage Entry red sandstone. Inside the 56' x 74' structure stood a hoisting engine more modern and larger than any of its predecessors.

When considering this hoist, Quincy was beginning to enter an age when it was more dependent on the knowledge and skills of outside manufacturers. Large hoists were not "off-the-shelf" items. While the engines and drums of a given manufacturer shared certain design features and numerous identical parts, each large engine was in part custom designed and built to meet the requirements of the purchasing mine. But Quincy by no means drew up its requirements on its own. It told bidding manufacturers what it wanted in general; the manufacturers then decided most of the details. The design and construction of hoisting engines had become a specialty, an area in which a mine like Quincy was no longer expert .

In deciding on the type of hoist it wanted at No. 6, Quincy apparently sought guidance and then bids from three companies: Webster, Camp and Lane; the M. C. Bullock Manufacturing Company; and E. P. Allis & Co.[13] Quincy considered, and then dismissed, the idea of using a tail rope in conjunction with the new hoist, so it could work more perfectly in balance.[14] The tail rope would have passed from the bottom of one skip down to the bottom of the shaft. There it would have passed around a sheave and gone up the other side of the shaft to connect with the bottom of the second skip. This would have abetted balanced hoisting, because the weight of the wire rope hanging below the descending, empty skip would have compensated for the weight of the longer length of hoisting rope attached to the full skip being hoisted. Without specifying just why, Agent S. B. Harris determined that a tail-rope at No. 6 "would not at all be advisable," perhaps because Quincy's shafts were inclined and not vertical, which might have interfered with the smooth operation of the tailrope. Also, at Quincy the rigging for a tailrope would have needed constant resetting, since the shaft was not constant in its depth, but was being driven deeper each year. Harris also discarded the idea of using two winding drums at No. 6 that could be operated "independently or cojointly."[15]

Quincy settled on a hoist built by E. P. Allis & Co. that cost $42,822, f.o.b. Milwaukee.[16] Unlike earlier Quincy hoists, this one was direct-acting. The drum was mounted on the engines' extended crankshafts and was moved without the assistance of a friction gear. The engines were more fuel efficient, because they had Corliss valves with cut-offs, instead of the old-fashioned slide valves. The single, cylindrical drum sat between two horizontal engines, each having a 40" bore and an 84" stroke.[17] The drum was some 21 feet in diameter and 12 feet across the face. Operating on 80 pounds of steam, the engine could hoist skips in balance at about 2000 feet per minute.[18] The original drum remained in use for a decade. In 1902, to reach greater depths, Quincy went to a new grooved, steel drum with a diameter of 22' 6".[19]

The engine was first put into service in the summer of 1892, and in October "a little smash-up" occurred:

> The mine's able engineer 'lost his head' and instead of stopping the skip at the dump, pulled it up to the top sheave timbers. The rope did not break but the skip became detached, and fell to the 22nd level, breaking the road only between the 15th and 17th levels. It was a lucky escape. . . .[20]

Following this accident, a safety stop of unspecified type was added to the engine that could override a neglectful engineer and brake the hoist automatically in such situations.[21]

Steam to power the hoisting engine came from a nearby boiler house constructed of stone. The 56' x 101' building housed, by the end of 1892, eight 6' x 6' return tubular boilers. "Mansfield" coal was the predominant fuel, and it was stoked by hand at least until the mid-1890s, when Quincy began experimenting with and then permanently installing mechanical stokers, which saved some ten percent in fuel costs.[22] By 1901, the No. 6 plant contained 12 return tubular boilers manufactured by the Roberts Boiler Works of Cambridge, Massachusetts. Each boiler was rated at 125 h.p. when providing steam at 100 p.s.i.[23] Besides serving the No. 6 hoist, the boilers provided steam to the new No. 6 compressor plant, which also began operation in 1892. This stone building (56' x 84') housed an Allis compound condensing compressor that was contracted for at a cost of $24,000. The two steam cylinders measured 30" x 60" and 54" x 60" and both air cylinders measured 30" x 60".[24] Running 30 r.p.m. on 90 pounds of steam, the compressor plant sufficed to run 80 No. 2 Rand drills. The air from this new compressor was carried underground in 10" pipes. For standby emergency use, Quincy took an old compressor, which had been located near the man-engine shaft, and moved it into an old Pewabic boiler house. If needed, this machine could drive some 20 drills.[25]

In the same year it opened its No. 6 shaft to the north, Quincy moved back to its southern ground, exploring it in much the same fashion as in the mid-1860s. Miners reentered the old side-hill adit, cleaned and repaired it, and in 1892 they extended the 1,100 foot tunnel another 200 feet.[26] In the following year they drove the adit 570 feet further; and in 1894, another 270 feet. The adit cut through a number of different lodes, but the result was always the same: no ground was rich enough to be worked.[27]

In 1894-1895 Quincy drove another adit that penetrated the ground south and east of the mine, but this one was much closer to established works than the side-hill adit. And unlike the earlier tunnel, which did not connect with any of the mine's drifts or stopes, the "East Adit" was holed to the mine's seventh level near the abandoned No. 5 shaft. The side-hill adit was purely exploratory, and once abandoned it could serve no purpose. The East Adit was for the "double purpose of exploring . . . east of the present workings, and for taking off mine surface water."[28] Like its predecessor, the East Adit failed to penetrate any copper bearing rock of value. But once the East Adit was holed to the seventh level, a launder running across that level and out the adit served to catch and then remove water moving down the mine.

In the mid 1890s, Quincy added a number of structures to its physical plant to make it more complete. Included were a carpenter shop and lumber shed, a warehouse, paint shop, pipe house, oil storage house, and a supply building. In 1897, Quincy completed an assay office and a new two-story, sandstone office building, which replaced the old frame structure. More significant, however, were the structures erected between 1893 and 1900 at the old No. 2 shaft and at the new No. 7 and No. 8 shafts.

With the No. 6 plant complete and working well, Quincy updated its facilities at No. 2 to match it. This construction had to wait for an important land acquisition. In 1893, No. 2 was 3,600 feet deep. To go much deeper, Quincy not only needed a new hoist; it needed to acquire important mineral rights from the St. Mary's Canal Company, owner of Section 23, just north of Quincy's Section 26. No. 2 was approaching the Quincy-Canal Company property line, and unless Quincy gained legal acces to the copper in Section 23, shaft No. 2 was going to be "cut off."[29] Quincy was in a bind, and the situation would have looked worse, if the company had not had a possible replacement for No. 2 -- if it had not had a location for a new shaft which it could quickly start to sink, if necessary.

Quincy was finally making tentative plans to exploit its southern ground. In the 1860s, the No. 5, 6, and 7 shafts had been rather quickly abandoned at shallow depths because the ground was consistently poor. But it turned out that in this portion of the mine, the copper improved with depth. After the closing of the three southernmost shafts, the area had been worked, when at all, by drifts running southeasterly from the No. 4 shaft. As the mine got deeper, these drifts started to get longer as they ran into richer copper rock. Finally, by at least 1893, it was clear that here was a block of ground that warranted more thorough exploitation, and that required a new shaft and attendant surface plant.[30] The tramming, hoisting and rock-crushing facilities associated with No. 4 could not handle the job.

The new shaft came to be called No. 7, and its mouth was right next to the No. 4 rockhouse. The timing of this shaft-sinking (it was commenced in December, 1897) was related to the fate of No. 2, and it reflected on Quincy's manner of negotiating land purchases from adjacent companies. In 1893, Quincy seems to have "leaked" plans for a new No. 7 shaft in order to get a better price for mineral rights to the Canal Company land along the route of the No. 2 shaft.

Quincy, as a ploy, acted as if it were ready to abandon No. 2. When the company first approached E. P. Allis for a new, large hoisting engine in 1893, it told Allis that the hoist was to be used at No. 7.[31] Seeing Quincy prepare for a new shaft presumably made the Canal Company more agreeable to coming to terms for Section 23. Quincy acquired the mineral rights, acquired the Allis hoist -- and put it at No. 2, not at 7, just as it had planned to do all along. Quincy proceeded with significant improvements at the old shaft, and put the new southern shaft on the back burner for a while.

Work at No. 2 was started in 1894 and completed the following year. Over the shaft Quincy erected a shaft-rockhouse "similar, in all respects, to the one erected at No. 6 two years ago."[32] The No. 2 and No. 6 shaft-rockhouses were alike in their machinery, layout and operation. They differed only in that the No. 2 structure was a mirror-image of No. 6; the left and right sides were reversed. Obviously, the No. 6 structure had fully lived up to Quincy's expectations for expedient, efficient rock-handling, as the structure was copied in all its important parts. Construction of the No. 2 shaft-rockhouse proceeded in a manner that caused as little disruption to the operation of the shaft as possible. While the old No. 2 shaft-house was still standing and working, Quincy carpenters erected the rock-house portion of the new structure.[33] Similarly, construction of the new hoist house went ahead without interrupting the old one. The new facility was located on a different spot, much further east of the shaft. And only when the new hoist was virtually ready did Quincy carpenters take down the old shaft-house and build a new one that connected with the almost-completed rockhouse. The new hoist and shaft-rockhouse started operation in June 1895.[34]

The new hoist was located in a hoist house, 58 feet long and 94 feet wide, similar in appearance to the 1892 structure at No. 6; its walls were fabricated of Portage Entry red sandstone; the roof was timber-trussed. The engine inside was one of the largest in the world. No. 2 was 3,600 feet deep; it would be sunk up to 200 feet deeper per year. Quincy wanted, and got, a hoist that could operate for 20 years, one that could hoist, eventually, from a depth of 7,500 feet.[35]

Selection of the hoist, as S. B. Harris noted, proved "considerable of a puzzle."[36] In this instance, the E. P. Allis Company seemed to have the job all the way. Quincy consulted closely with Allis and with no other companies. The two parties considered three major options. After "studying hard," Mine Agent Harris, in early January, 1894, thought they had a "sure plan to operate a straight drum with the 'tail rope' system."[37] But that plan was shelved as being impractical after all. Next Quincy and Allis considered the merits of a "double cone drum" -- a drum that was cylindrical in the center and carried a cone on each end. This design was deemed more "economical in operation" because it required an engine to do less work at the beginning of a lift, when its rope was winding on the small end of the drum.[38] The Tamarack Mine had recently installed an engine with a conical drum that cost $65,000 and could carry 6000 feet of 1-$^1/_4$" wire rope.[39] By ultimately resorting to just a straight (or cylindrical) drum with no tail rope, for $60,000 Quincy acquired an engine that could carry 7,500 feet of 1-$^1/_2$" rope.[40] Quincy gave up greater efficiency, but in return it obtained, for less money, a hoist that could reach greater depths.

The 2,500 horsepower hoist was the largest that Allis had ever built. Its two horizontal cylinders (one on either side of the drum) had a bore of 48 inches and an 84 inch stroke. The cylinders were equipped with Reynolds-Corliss valve gear, and the engine ordinarily ran at 32 r.p.m. under 100 to 125 pounds of steam. The hoisting drum, grooved to accept the hoisting rope, was 26 feet in diameter, and 12-$^1/_4$ feet across the face. The engine could hoist skips in balance at a rate of 2,500 to 3,000 feet per minute.[41] On June 10, 1895, after long months of worry concerning the hoist's design, construction and installation, S. B. Harris wrote Thomas F. Mason that, "It will do your heart good to see that equipment in operation; everything runs as slick as a whistle, and the way the rock is hoisted out of the shaft is an eye opener to many." The engine hoisted larger skips, and hoisted them faster. It was believed capable of hoisting 1,000 tons of rock per 24 hours.[42] With the improvements at No. 2, the mine would be able to keep about 4-$^1/_2$ steam stamps at the Torch Lake Mill in constant operation; the mill had opened five years earlier with three stamps.

After getting a new lease on life for No. 2 in 1893, Quincy was in no particular hurry to push the new southern shaft, No. 7. In 1895, S. B. Harris wrote Mason that "in all probability" the shaft would be sunk "sometime."[43] Harris, looking far ahead, noted that at a depth of 5500 feet the future shaft would leave Quincy property and strike the southeast corner of Section 22. The mineral rights there were held by the Hancock Mining Company. Those mineral rights, Harris wrote, were "a desirable thing for us to have. I would advise quietly looking the matter up so as to be ready to act when the proper time comes." Quincy in all probability did consider and investigate the acquisition of mineral rights to Section 22, but it did not obtain them. In December 1897 it finally started work on No. 7, and hoisting began there on October 3, 1900.[44]

The No. 7 shaft was novel in two regards: the manner in which it was executed, and its course. All earlier shafts at Quincy had been sunk solely from the surface down. Hard behind the shaft-sinkers came the drifters, and behind them, the stopers. The other shafts also penetrated areas that had never been opened before. No. 7 presented a different situation. First of all, it was known that a long stretch of ground starting from the surface would be poor. Secondly, drifts coming over from No. 4 had already opened up part of the richer, deeper ground along the proposed route of No. 7. In short, Quincy had the opportunity and the need to drive the shaft quickly to a substantial depth, where the copper was. Instead of starting at the surface and having only one working face to push downward, Quincy used existing drifts to gain access to the route of the shaft, and from these lower levels it started to sink and raise the shaft simultaneously.[45] By 1898 the shaft was being attacked from several levels underground and from the surface down as well. Underground, broken rock was removed by tramming it to No. 4. From the surface, until a new No. 7 engine was installed in 1900, Quincy hoisted the spoil with an old engine salvaged from Pewabic.[46]

Getting the shaft sections to meet properly was no mean feet. It required great skill on the part of underground surveyors, particularly since the shaft took the form of a catenary curve.[47] This curve was well suited to the changing dip of the lode, which flattened out with depth; it also allowed for greater ease in maintaining the hoisting rope, which would virtually hang free in the shaft. In the other shafts, which were not particularly regular or true in following the lode down, the hoisting rope had to ride over wooden rollers to keep it from wearing against rock or timbers. Sometimes the rollers were placed at track level; sometimes on the roof of the shaft. The rollers needed regular maintenance and replacement, particularly since a faulty roller could be set afire by the friction of a moving wire rope. At the No. 7 shaft, this work and danger were largely eliminated.

On the surface, No. 7 demanded the usual support facilities. The shaft-rockhouse, some 100 feet high, was unusual in that it was of steel-frame construction, instead of wood. Quincy had always built its own wooden structures, using its carpenters. When it turned to structural steel for this shaft-rockhouse, and for other steel structures which followed, Quincy had to turn to outside firms with expertise in handling this material. In March 1899 Quincy entered a \$32,000 contract for the shaft-rockhouse with the Wisconsin Bridge and Iron Company.[48] Presumably, the equipment inside this structure (which was not covered in the building contract) was essentially the same as that found at No. 2 and No. 6.

The No. 7 hoist was installed in yet another sandstone building, this one measuring 58 feet by 94 feet. S. B. Harris closed the contract for the engine in July 1898 with E. P. Allis; the engine was due in a year's time. The new hoist, in its general configuration, was very similar to the No. 2 hoist, but it was even larger.[49] In 1900 the Copper Handbook noted that the Allis hoist "has few equals in the copper district or at any mine in the world."[50]

Quincy acquired the direct-acting hoist for \$60,550. Its bore measured 52 inches and its stroke, 84 inches. Again, Quincy chose a grooved, cylindrical drum. This drum was 28 feet in diameter and had an 11-$^3/_4$ foot face. It could carry 8,000 feet of 1-$^1/_2$ wire rope. Like the No. 2 engine, it was equipped with a safety stop and speed regulator, and it hoisted at up to 3,000 feet per minute. It also had steam brakes, Corliss valve gear and was reversible. Unlike the No. 2 engine, the two cylinders at No. 7 were not steam jacketed.[51] Steam for the new engine was provided by a No. 7 boiler house, a 56' x 92' stone building with a steel truss roof, located south of the No. 4 boiler. The structure housed eight new horizontal, return tubular boilers.[52]

While developing No. 7 on the south, Quincy was simultaneously preparing its No. 8 or "Mesnard" shaft to exploit the northern reaches of the Pewabic Lode. S. B. Harris had been considering the advisability of revamping one of the five small, shallow, and crooked Mesnard shafts by at least 1897.[53] For a while the project was held off as Quincy waited to see if the Franklin Mine would fall into its hands. If Franklin failed, Quincy was tentatively planning to rehabilitate its No. 5 shaft.[54] But Franklin continued to hang on, so by March 1899 Quincy was set on having a Mesnard shaft, which would be productive and yet exploratory. Quincy was not certain just how rich the ground would be, although it had gained some idea via an exploratory trespass. Quincy had driven its 43rd level north from No. 6, passing it under the Franklin Mine and across to its Mesnard property.[55] From this drift, Quincy had opened a stope rich in copper, and presumably trammed the rock southward under Franklin and back to Quincy's No. 6 shaft for hoisting. Quincy was not too worried about getting caught, because it knew that Franklin, between its 36th and 37th levels, had wandered north of its property and into Quincy's Mesnard holdings. Two wrongs did not make a right, but in any legal case the trespasses would tend to cancel one another out.

Quincy seemingly considered the prospects of mining its Mesnard property without sinking a shaft there; the rock could be trammed along the 43rd level to No. 6. But this idea was discarded.[56] Quincy unwatered an old Mesnard shaft in July 1899 and started to enlarge it to three compartments (one for each skip and one for a ladderway) and to strengthen it from the surface down.[57] By the end of the year, Quincy had sunk it to 275 feet, and had opened one level only, 244 feet below the surface. At No. 7, Quincy had known the nature of the ground to be worked there, because the drifts going south from No. 4 had penetrated it. So the company had gone all the way in installing a modern and expensive physical plant. At No. 8, the same condition did not hold. Quincy wisely reverted to a more tentative, conservative plan. The new shaft-rockhouse at No. 8 contained the usual drop and steam hammers, but only two rock breakers, instead of the usual five.[58] Quincy relied heavily on used machinery when equipping an economical, combination boiler-hoist-compressor house.[59] The smallish Rand compressor with a 12-drill capacity was new, but the No. 8 hoist (good for a depth of 4,000 feet) was taken from the 1882 hoist house at No. 2, and the two 80-horsepower boilers came used from the Pewabic Stamp Mill on Portage Lake.[60]

Quincy pushed the shaft-sinking at No. 8 with great dispatch, trying to drive it into paying ground. In 1901, the No. 8 hoist accounted for only 4% of the copper rock brought to the surface by Quincy, but at the same time it accounted for 48% of the poor rock.[61] By March 1903 the No. 8 shaft was down to 2,200 feet, and still it was a long way from good copper rock. Through information gained by its trespass under Franklin, Quincy knew that good ground lay 1400 feet south of the No. 8 shaft (or right near the Franklin property). It would be expensive to reach this copper with long drifts -- six drifts running a total of 8,400 feet would cost $55,000, when figured at $6.50 per foot. Other good ground lay 1200 feet below the route of the shaft; to reach that deposit would cost some $26,500. To develop No. 8 and to exploit fully the copper below the shaft and on its south side, would cost close to $82,000 and take 2-$^1/_2$ years.[62]

These figures discouraged J. L. Harris, and in 1903 he reconsidered the option of purchasing up the Franklin Mine and of exploiting the northern reaches of the Pewabic Lode through Franklin's No. 5 shaft.[63] This shaft was more centrally located and much closer to Quincy's other shafts; it would allow Quincy to get to the productive ground just north of the Franklin property line faster, using shorter drifts; and the existing hoist and other machinery at Franklin's No. 5 shaft would be sufficient to answer all needs for some time. If the Franklin Mine could be purchased for less than $100,000, Harris believed it would "pay to abandon the No. 8 shaft."

But Franklin was not available, at least not at a price Quincy was willing to pay, so the No. 8 shaft continued in operation. By 1905 the ground tributary to that shaft had been opened enough to alow J. L. Harris to "estimate that we have sufficient good grade stoping ground to last us for about 25 years when hoisting at the rate of 1,000 tons per day."[64] Accordingly, in 1905 Quincy ordered a new hoist for No. 8 from Nordbery that could reach a depth of 5,000 feet while pulling larger skips with an 8-ton capacity.

Again, in selecting this hoist, Quincy shopped around and sought the advice and guidance of several manufacturers: Allis-Chalmers; Wellman, Seaver, Morgan; the William Tod(dü) Co.; and the Sullivan Machinery Co., in addition to Nordberg.[65] Quincy consulted R. A. Swain of the Power and Mining Department of General Electric, seeking information on the suitability of an electric hoist.[66] The company also consulted with Prof. O. P. Hood of the Michigan College of Mines.[67] Quincy weighed the merits of a 7,000-foot capacity hoist, before deciding that a hoist going to only 5,000 feet would be cheaper and yet adequate for 20 years.[68] It once again studied the advisability of a tail-rope system, before discarding the idea.[69] It studied conical and straight drums, and compound and simple engines. After some six months of research, Quincy settled on a Nordberg machine priced at less than $30,000. The horizontal, reversible, direct-acting hoist had two cylinders (32" bore and 72" stroke) that operated on 115 pounds of steam.[70] The most novel part of the hoist was its drum. For the first time Quincy moved away from a straight drum; the cylindro-conical drum was 18' 6" in diameter in the center and tapered to 12' 6" at each end.

Since 1892, Quincy had opened new shafts Nos. 6, 7, and 8. It had rehabilitated its facilities at No. 2, and in 1895 it had also built a new shaft-house at No. 4. It had built a number of new storage buildings, a new carpenter shop and company offices. Still, the improvements were not complete.[71] In 1899 and 1900, Quincy added:

> -- a No. 2 boiler shop that contained 4 Wicks vertical water tube boilers rated at 250-horsepower each;
>
> -- a No. 2 compressor building that housed two "of the finest air compressing machines ever built." The Rand, cro-s-compound, two-stage compressors had a capacity of 60 drills each. These machines nearly doubled the mine's drill capacity; they could provide air to any part of the mine, including the No. 8 shaft, via pipelines;
>
> -- a fully equipped blacksmith shop located between the No. 2 and No. 6 shafts;
>
> -- next to the blacksmith shop, a fully equipped machine shop for both fabricating and repairing mine machinery and tools. (Incidentally, the machinery here was group-driven by an electric motor, rather than by a small steam engine. Electric power is c. 1900 began to play a more important role at the mine.)

With these structures completed, the building boom started in 1891-1892 was brought to a close. Quincy had passed through its most dynamic growth period, in terms of construction and production. In

1890 Quincy produced 8 million pounds of copper ingot; in 1901 it produced 20.5 million pounds. This rise was made possible by the large and modern physical plant which Quincy had built. This plant continued to undergo change, but in large part it sufficed to serve the mine up to its shutdown in 1931. After c.1900, any expansion in one part of the plant was usually offset by a contraction in another. Quincy had made its last big production jump. The highest copper production ever achieved at Quincy was 22.5 million pounds in 1909 and 1910, only two million pounds more than was produced in 1901.

The expansion on the surface in the 1890s was, of course, paralleled by an expansion of the underground works. Shafts 6, 7, and 8 opened up new blocks of ground. The No. 2 shaft from 1890 to 1900 descended from the 40th to the 56th level; No. 4, from the 40th to about the 50th level.[72] Not only was more ground accessible; more rock was baken out of each opened area. Quincy's exploitation of the Pewabic Lode changed in a profound way: it took out low-grade rock that prior to 1890 it had passed over. Consequently there was a "large and continuous decrease in the yield of refined copper per fathom of ground broken." This falling off seemingly alarmed some Quincy shareholders, who mistakenly thought that the decrease meant the mine was slumping. But in 1893 S. B. Harris explained the decrease in another way:

> When the percentage of mineral rock stamped was 2.8% or 3%, all the barrel work -- now (called) 'little hammer' mineral, went in as stamp product. In those days -- the days of the old mill -- the high grade rock only was stamped, otherwise the copper product could not be kept up. It was like picking the biggest apples -- or digging the largest potatoes, and leaving the 'low grade'

> for future generations to glean. We could not pursue that policy now if we desired to, because it would be impossible to get enough of such rock to supply the (new Torch Lake, steam-stamp) mill. We now, both from choice and necessity, mine larger quantities of 'low grade rock' and thus make money in many ways too numerous to mention.[73]

To maintain a production of even 6 million pounds in the 1880s, Quincy had to pass over poorer grades of rock -- even if they might have been profitably mined -- because of its limited stamping facilities at the Portage Lake Mill. The most the gravity stamps there ever handled was 118,000 tons of rock in 1889.[74] As long as Quincy had a limited stamping capacity, of necessity it had to handle only the richest rock. In 1890, the new steam stamps at Torch Lake broke the bottleneck. Throughout the 1890s, by mining poorer, yet profitable rock, Quincy increased its tonnage to keep the Torch Lake Mill operating to capacity. In 1890 Quincy stamped 165,000 tons; in 1895, 495,000 tons; in 1899, 559,000 tons.[75] In 1900 Quincy opened a second stamp mill at Torch Lake and a year later stamped 886,000 toms of copper rock. The yield per ton of rock stamped dropped markedly, from 2.8% in 1889, to 1.5% in 1895, and to 1.2% in 1901.[76] But ingot production tripled, and so did Quincy's annual dividends, from $280,000 in 1889 to $900,000 in 1901.[77]

Underground, Quincy continued to use the advancing system and pillared and timbered sparingly. Two-man air drills and high explosives continued to be the rule. Quincy still used Rand, and perhaps some Ingersoll, drills, and to expedite the drilling of blasting holes it mounted two machines on one column whenever possible.[78] With Rand machines, Quincy miners were able to drive holes as much as 10 to 11 feet per hour. They used a cross or rose bit in driving each hole the first three feet and then switched to a plain chisel bit to reach the final depth of up to twelve feet.[79] In 1902, R. A. Swain of General Electric tried to interest Quincy in electric drills. S. B. Harris considered the merits of the Durkee electric drill, but doubted it could outperform the mine's present equipment.[80] Besides, Harris recognized that the air exhausted from the Rand drills was a beneficial side-effect of their operation, a "very important factor in ventilating close drifts and stopes."[81] In 1902, Quincy used 130 air drills; in 1904, it operated 180 drills in drifting and stoping.[82] These figures were up sharply from the 25 or so air drills operated in the late 1880s.

It had been this kind of increase in machinery which had prompted Quincy, in 1899-1900, to build new blacksmith and machine shops. The drilling machines received hard usage and demanded frequent maintenance and repair. The drill bits themselves were consumables. Quincy purchased large lots of blank drill steels that first had to be cut to length, forged, and sharpened. Once in use, they had to be kept sharp. Each day, dull drills were hoisted to the shaft-rockhouse and transported to the shop, where they were annealled in coke forges, sharpened, and then tempered in a second bank of forges. Prior to 1903, Quincy smiths sharpened all drills by hand. In that year Quincy, on trial, used an Eclipse drill sharpening machine and found it lacking. In 1904, however, the mine had better luck with a drill sharpener built by J. B. Word in Hancock.[83] Word installed and operated two of his machines at Quincy at his own expense. Quincy was pleased with their performance. An operator, who heat-treated the drills as well as sharpened them, could handle 500 in a 10-hour day. By the start of 1905, Quincy had four Word machines, each costing $1,800, and they could handle all the mine's needs.[84] The machines were first located in a drill shop near No. 7; in 1908 they were moved into the 1900 blacksmith shop.

By 1900 Quincy apparently used no black powder at all for blasting and relied exclusively on nitro-glycerine dynamite:

> We are using the Lake Superior Powder Company's powder and have done so for several years. We have tried almost every other kind of powder in the market -- and on the whole like this a little better than any other. We have tried different grades -- mostly 45% and 50% -- and find that for our use the 50% is the most satisfactory. . . . We have no complaints from the men in regard to ill effects of the gases . . . . Of course, any powder in a close place will make more or less nasty fumes, -- but, in fact, we have had less trouble, or complaint, in this respect, than from any other high-explosive we have used.[85]

In 1901, Quincy used about 80,000 pounds of powder per month, or 960,000 pounds of high explosives per year.[86] The cost of this material probably approached 12 cents per pound, or nearly $115,000 annually. The powder account, then, was a significant part of the company's mining expenses, and in 1901, W. R. Todd apparently tried to get S. B. Harris to move to a less expensive explosive. This was not the first time that the New York officers had tried to influence the Agent's choice of powders, and it would not be the last. The tone of S. B. Harris' repl- to Todd made it clear that he disliked the officers' meddling:

> We have tried lower and cheaper grades of powder . . . such as is used in some of the neighboring mines -- but were losers by it. We can get that same kind of (low-grade) powder today for 10-$^1/_4$ cents per pounds -- but don't want it. We at the mine are certainly the best judges.[87]

Harris and Todd seem to have fought to a draw on this issue. Under Todd's direction, Harris contracted with Lake Superior Powder to receive ammonia powder in lieu of straight nitro-glycerine dynamite, at 1/2 cent per pound less.[88] If a complete substitution were made, Quincy would save $4,800 per year. But this contract was for only 6 months, not for the usual year. Harris was giving the ammonia powder a trial, to see if it broke as much ground as the nitro-glycerine. It must have had a mixed success. In 1904, Quincy and Lake Superior Powder negotiated prices for 40, 45, and 50 percent grades of both nitro-glycerine and "Excelsior Special Ammonia." The ammonia explosive, for each grade, cost a half-cent less per pound. The 50% ammonia cost 11.375 cents per pound; the nitro-glycerine dynamite, 11.875.[89] Still, there is some evidence that Harris continued to lean towards nitro-glycerine, because a subsequent agent, Charles Lawton, later claimed credit for the switch to ammonia powder.[90]

Explosives were not alone in the economic scrutiny they received. If the mine consumed a large quantity of any material, sooner or later the management would study potential savings to be derived by moving to a new supplier, a new product, or both. Such was the case with underground lighting devices in 1896-1897. Prior to September 1896, Quincy had always provided its miners with candles, first made of tallow and later of stearine. Then the company experimented with paraffin-based fuels -- "sunshine" and "moonshine" -- to be burned in small lamps.[91] Economics motivated the switch from candles, as S. B. Harris made clear in an 1897 letter to W. R. Todd:

> For some time we have experimented with the so-called "sunshine" and "moonshine" -- for there are two kinds -- with very satisfactory results -- and as I have the figures right here it may interest you to look at them . . . . Four men use an average of 75 lbs. of candles per month -- or 70 lbs. of "sunshine," which at the average cost of 8-$^1/_2$ and 4$^1/_2$ cents respectively make(s) a difference of about 81 cents per man per month in favor of "sunshine." In May about 480 of our men used the "sunshine," and 480 x 81 cents means $380.80, which tells a pretty good story.[92]

With the agent watching so carefully after such relatively small savings, it is no wonder that Quincy had become known as "Old Reliable" because it so regularly turned a profit.

Not surprisingly, given the great increase in the amount of rock handled, the most significant underground changes involved transportation -- tramming and hoisting. Tramming remained little changed from the opening of the mine till the turn of the century. Tram-cars, pushed by hand, moved along lightweight rails having a 28" gauge, which were spiked to 6" x 6" cedar ties. The rails were graded along the drifts, so that they descended 15 feet per lineal run of 100 feet.[93] Despite the downgrade, tramming was a most arduous task. Trammers were unskilled, but strength and endurance were requisites. As Quincy was to learn, its trammers could also be inflammatory, when it came to labor unrest.

In 1896, Quincy trammers struck to ease their burden. As a result of the strike, the company (temporarily, at least) had to allow three men to move each car, instead of just two.[94] A labor-intensive operation now became even moreso. By 1900, but certainly not for the first time, management sought a means of reducing the costs of tramming and, perhaps, a means of reducing the number of unruly trammers it had to employ. S. B. Harris wrote to W. R. Todd:

> Your remarks concerning underground haulage are suggestive, but the subject is not at all new to us. You say "difficulties don't seem to us insurmountable," etc. Mr. Mason used to say -- "you can do anything with men, and money." Perhaps, but in this case . . . we fail to discover, or invent any method that will pay -- here is a chance for you to immortalize.[95]

Quincy wanted to mechanize tramming, but it was not sure of how. By March, 1901, Harris thought he had a solution: the mine would install "pony engines" along the longest drifts, driven by compressed air tapped from pipes initially installed for air drills. The small engines would operate the cars attached to a "small endless steel rope." Harris was sanguine about the idea:

> We think this plan will prove to be as simple, and effective, and economical, as anything yet devised for such work as ours. This plan, if successful, and I have no doubt of it -- will solve the problem of long distance, underground haulage. . . .[96]

Quincy seemed determined to mechanize tramming, but pony engines and cables did not prove to be the way. An outside expert in another, newer form of motive power was brought in to study the problem, probably by the New York officers. The man was R. A. Swain, from General Electric. Quincy, starting some 40 years earlier, had moved from a non-mechanized era into one of steam and compressed air. Now, partially at least, it would turn to electricity for motive power.

Swain had a product to sell -- small electric locomotives running off trolley wires -- and he sold it. Swain convinced Harris that it was not only practicable, but that it would be "a saving investment . . . to operate a few, say two, or half a dozen of our long lower levels by electricity."[97] An electric locomotive would run along each level, hauling two or more cars at a time.

Swain visited Quincy in the spring; by mid-December, 1901, one locomotive was in place on the 43rd level, north of No. 6, and preparations were underway for another on the 49th level.[98] Harris wrote Todd:

> . . . we are convinced that this Electric Haulage system will practically revolutionize underground tramming and when the storage battery is perfected to such an extent as to be applicable and practicable, in such cases as ours -- thus eliminating the expense of (trolley) wiring -- the success to be assured.[99]

Quincy was innovating; it was the first Lake Superior copper mine to make this "notable improvement" in underground haulage.[100] The first locomotives proved successful and encouraged Quincy to purchase more. By the end of 1902, about half of the rock hoisted at No. 6 was electrically trammed. Four electric locomotives and 36 steel cars ran underground, and Quincy had placed orders for ten more G. E. locomotives.[101] By the end of 1903, 15 locomotives were in operation.[102] The power to drive the locomotives came from a local utility, the Peninsula Electric Light and Power Company.[103] The commercial alternating current, taken underground, operated a motor-generator. An induction motor drow a 20-kilowatt, and later a larger 100-k.w., direct-current generator. Locomotives picked up their power from bare trolley wires strung overhead along the drifts.

The locomotives were used on long haulage runs of 2,000 to 3,000 feet. The squat locomotives, only two to three feet high, less than four feet wide, and nine feet long, weighed 5,500 pounds. Each locomotive had nine cars in its "stable." While it was transporting three

3-ton cars (at 6 to 8 miles per hour), three others were being filled and three were being dumped.[104]

The electric locomotives were labor-saving and considerably reduced the cost of tramming. J. L. Harris compared the relative costs of hand and electric tamming for may 1902, when the new system was still handling only one-fourth of the rock hoisted at No. 6. During this month, two locomotives transported 7,7037 tons at 13.66 cents per ton; the cost of hand tramming was 16.66 cents per ton, or 3 cents more. The savings was achieved by a reduction in labor. With a locomotive, seven men (four loaders, two dumpers and one motorman) could transport 132 tons of rock across the longest level in each 10 hour shift. To move the same amount by hand required twelve men.[105] By February 1903, Harris was figuring the cost of electric tramming at 12 to 13 cents per ton; of hand tramming, about 20 cents.[106] Electric haulage reduced the number of trammers needed; this mechanization also encouraged Quincy to reduce trammers' wages, from $60 to $55 per month.[107]

Electric tramming did not come off without a few hitches. In 1903, the motor-generator set burnt out and had to be replaced, and having to service and maintain the equipment underground also caused some problems.[108] But on the whole, electric haulage proved very successful in moving the mine's rock, and by 1905 some locomotives -- running between shafts 6 and 8 -- had runs of up to 4,000 feet. Once introduced, the locomotives remained in use until the mine closed. Twenty locomotives operated by 1910; twenty-five by 1917.[109] In the next year, four storage battery locomotives, which Harris had foreseen in 1902, finally arrived.[110] In part, the success of electric was attributable to improvements made in the manner of putting trammed rock into skips.

From the beginning of the mine until the introduction of electric tramming, trammers had unloaded their cars directly into kibbles or skips. The system was a liability. Unless the timing was perfect, either the trammers or the skips were idle, waiting for the other to arrive. Beginning in 1902, this mode of operation underwent change:

> We have under consideration a system for underground tramming which, so far as we can see at the present time, will be a success, and lessen the cost of tramming and hoisting materially; and especially so with electric haulage. The scheme we have in view is depositing the rock trammed in suitable bins, so constructed between the levels that rock can be run direct from same in the skips. . . . If our plans, when perfected, are a success, it will mean an innovation in underground tramming and hoisting, and there will be no delay . . . to the skips is waiting for trammers, as is somethimes the case now . . . .[111]

Quincy, on its most active productive levels, cut its bins or pockets on the hanging wall side of a shaft. Each bin had a capacity of some 500 tons.[112] Trammers dumped stamp rock directly into the downward sloping bins. At the shaft, a filler controlled the operation of a chute that, when opened, allowed rock to fall into the skip. According to one knowledgeable observer, the storage bins -- so facile in concept and yet so long in coming -- added at least 25% to the mine's hoisting capacity.[113] The skips, idled less frequently, made more trips per shift. The rock bins, in conjunction with electric haulage and new, larger rock skips, placed Quincy if a position to handle about 1,200 tons of rock from each shaft per 24 hours.[114]

At about the same time as it introduced underground bins, Quincy made another important improvement in skip loading. At the depths it was then working, the lode was much "flatter than nearer the surface." The dip of angle of the lode (and thus the angle of the shafts) had declined from some 54 degrees to about 35 to 40 degrees. The skips, then, while at rest at the loading stations, were inclined more towards the horizontal and harder to fill to capacity. So at each station, Quincy modified the skip roads and installed tilting devices. In essence, the devices allowed the rear skip wheels to fall, thus tipping the mouth of the skip up so the vehicle could be filled more readily.[115] In addition to streamlining the filling operation, Quincy significantly enlarged its skips so a greater tonnage could be carried on each trip.

The old shafts, Nos. 2 and 4, had been double-tracked and hoisting in balance had been initiated in 1890-1891. All of the new shafts -- Nos. 6, 7, anf 8 __ were double-tracked from the start. The first skips used for balanced hoisting at shafts 2 and 4 weighed two tons empty and had a three-ton capacity.[116] As new, more powerful hoists came into use, and as the desire was felt to boost production, the mine turned to larger skips. When the No. 6 shaft opened, it apparently used 4-$^1/_2$ ton skips.[117] When the new Allis hoist was placed at the No. 2 shaft in 1894, Quincy virtually doubled the capacity of the skips there from 3 to 5-$^3/_4$ or 6 tons. To carry this out, miners had to enlarge and straighten the shaft, and timbermen relaid the skip roads, which now carried heavier rails, weighing 50 or 60 pounds per yard.[118]

By 1902, the skips at No. 7 could carry 8 tons of rock, and by the end of the next year, shafts 2 and 6 were also equipped with 8-ton skips.[119] The No. 4 shaft, barely hanging on by this time, apparently never used the larger skips. Except for that shaft, over a ten year period Quincy's skips almost trebled in capacity, from three to eight tons. And while Quincy's earliest skips, with a capacity of perhaps two tons, had been raised at a rate of only 500 feet per minute, the eight-ton skips by 1905 traveled at up to 3,000 feet per minute.[120]

Throughout this period, Quincy continued to fabricate its own skip bodies in its shops out of angle iron and sheet steel. Generally the increased capacities were achieved not by making the skips wider or taller, which would have necessitated increasing the shafts' dimensions beyond their 6-foot by 19-foot size,[121] but by making them longer. The 6-ton skips were 44" or 48" square, and 9 or 10 feet long. (The skips in the various shafts were all slightly different.) The 8-ton skips were as wide and tall, but 12-$^1/_2$ feet long.[122] In 1923, when Quincy would make its last jump to 10-ton skips, they were just over 15 feet long.

During this period, Quincy also made notable changes in its manner of transporting men and unwatering the mine. When the mine operated only shafts 2 and 4, the man-engine between the two had sufficed for transporting men up and down. But by the early 1890s, the engine had about reached its maximum operating depth. Also, with the sinking of the No. 6 shaft, the underground workings were more extensive, and the single access point offered by the man-engine proved invonvenient. For the men at No. 6, Quincy in 1892 resorted to a "man-car," which was really a specialized skip.

The four-wheeled man-car rode the skip tracks. (See the HAER drawing of hoisting conveyances.) At the beginning and end of each shift, men in the shaft-rockhouse removed the rock skip from the end of one hoisting rope and attached the man-car. The long vehicle contained a tier of 10 benches, each of which could seat three men. In operation, the man-car was much like a rock-skip; the hoist engineer could stop it at any desired level to discharge or take one men. Since up to 30 lives were involved, however, it did require some safety precautions. The standard operating procedure, known to be in force by 1922 and perhaps much earlier, was to move an empty man-car down and back, to assure that the shaft was clear before any men were transported.[123]

In 1893, the man-engine was extended from the 38th to the 40th level; it had attained the "limit of its usefulness."[124] By August 1895, the mine had stopped using the man-engine altogether.[125] Shafts 2, 4, and 6 all had man-cars, as did all later shafts. To facilitate the switching of hoisting vehicles, Quincy eventually installed small cranes in its shaft-houses to move and lift the various skips, and to hold them up out of the way when not in use. By 1902, Quincy reportedly could switch a man-car for a rock-skip in only two or three minutes.[126]

When it discontinued the man-engine in 1895, Quincy also "practically discarded" its mine pump.[122] Instead of mechanically pumping water, Quincy channeled underground water in the upper levels to the launder that carried it, by gravity, out of the mine via the East Adit. By the late 1890s, water in the lower levels was piped to a reservoir or sump at the bottom of the No. 4 shaft,[128] and was hoisted to the surface in another specialized skip. The water- or bailing-skip was basically a wooden box on wheels with a 1300, and later a 1600, gallon capacity. It received water from the sump and carried it to the surface, where it was dumped. By 1903, sumps were also constructed at the 56th or 59th levels of shafts 2, 6 and 7. This readied the mine for the eventual abandonment of the No. 4 shaft, which in 1902 had accounted for 65% of all water bailed from the mine.[129]

Quincy made money when it hoisted copper, not when it moved men or water. So the rock skips were kept in operation the vast majority of the time. Man-cars went on the hoisting rope only at the start and end of each shift; in between, a man stayed underground or took a dangerous ride on or in a rock skip. Quincy usually didn't bail its water during the week, but on Sunday, or late on Saturday, when there was no second shift.[130] Sixty to 120 water skips (using one or two at a time) might be raised in each shaft,[131] at a time when they did not interfere with rock hoisting.

Quincy's growth in the 1890s had been directed by Agent S. B. Harris. Harris, who had first taken command at the mine site in 188 , served until 190 . In 1894, Harris had written company president Thomas F. Mason that:

> In relation to our New Work, it seems that if we aim to increase our product materially, we should lay out for <u>doubling</u> it, and that means duplicating out present plant. . . .[132]

Five years later, in looking at the "new work," Harris wrote Mason that, "it is something like the condensation of the work of a lifetime. It has been a hard struggle, but we will 'get there' all the same."[133] Harris indeed "got there." Before retiring he succeeded in rebuilding the mine.

The Agent was followed by his son, J. L. Harris. In 1905 the younger Harris responded to a quiry from a William B. Mather, who was apparently penning an article about the important technological contributions made since the 1880s by mining engineers. Mather sought a quotable quote from J. L. Harris, himself an M.I.T. traduate, that would laud the role the mining engineer had played in Quincy's development. Mather must have been surprised by Harris' reply:

> Concerning the information you ask for in relation to the improvements between now and twenty years ago, (I) will say that the better mechanical appliances, such as power-drills, hoisting, compressing, pumping, etc., we owe principally to the Mechanical Engineer, but in our case, we do not, as you surmise, owe to the Mining Engineer the improvements made in development work, but are under obligations to the Mine Superintendent and Chief Mining Captain.
> The principal duties of the Mining Engineer here have been in connection with the mine surveying, mapping, etc., only.[134]

Quincy had become very dependent on academically trained engineers, but they did not work at the mine. The worked in the eastern and mid-western shops that developed the machinery and tools that Quincy bought in the market place. In 1884, Quincy had but one employee trained at a technical school; in 1894 it had but two. In 1904, it had five, but only one -- J. L. Harris -- was in a high-ranking capacity. Quincy still preferred the mining savvy gained through years of long experience. Interestingsly, S. B. Harris, an up-the-ranks individual, enjoyed a long tenure as Agent, and although he sometimes disputed technical and economic questions with the company's officers, he had their respect. His son, the M.I.T. graduate, was in trouble from the beginning, garnered no deference from the eastern officers, and left in 1905.

"Practical" men had rebuilt the Quincy Mine, and in 1905 it little resembled the mine of fifteen years earlier. On the surface and underground, much was new. But the appearance was, in an important way, misleading. Quincy was getting to be an old mine. Never again would it experience any substantial growth in product. Sustaining the already-achieved level of 16 to 22 million pounds annually would in itself prove difficult. Quincy would soon suffer expensive and debilitating infirmities, and it would constantly have to cope with the economic and technological problems brought about by the mine's ever greater depth. Quincy had been profitable every year since 1868, and the company would continue that string from 1905 to 1920, but not without effort, and not without the knowledge that each year brought the company closer to an eventual shutdown. There was a limit to how far down it could go, exploiting an ever narrower veir of copper rock, and in 1905 Quincy miners were already 5,000 feet below the surface.

NOTES -- CHAPTER THREE

1 Stevens, The Copper Handbook, v. I, 1900, p. 223.

2 Copper Handbook, v. III, 1903, p. 462.

3 QMCo, "Map of Quincy Property and Vicinity," c. 1910. This map marks off Quincy's land acquisitions after 1891 and gives the date of each. See photocopy in HAER collection.

4 QMCo, 1891 Annual Report, p. 12.

5 QMCo 1892 Annual Report, p. 12.

6 QMCo, 1891 Annual Report, p. 12.

7 Thos. F. Mason to S. B. Harris, July 2, 1888; N. Daniels to S. B. Harris, July 20, 1888. Neither letter explicitly states that Quincy had trespassed on Pewabic ground, but they strongly imply that a trespass has occurred.

8 QMCo, 1891 Annual Report, p. 12.

9 S. B. Harris to W. R. Todd, Nov. 4, 1891.

10 QMCo, 1892 Annual Report, p. 15. All the other new buildings at No. 6 were also lighted electrically.

11 S. B. Harris to Thos. F. Mason, Dec. 22, 1891; Charles T. Hodge to S. B. Harris, Feb. 19, 1892; S. B. Harris to Wm Sellers & Co., Feb. 15, 1892.

12 The best published description of rock-handling in Quincy's 1892 (No. 6) and 1894 (No. 2) shaft-rockhouses is found in

13 S. B. Harris to T. F. Mason, April 17, 1891.

14 M. C. Bullock Mfg. Co. to S. B. Harris, Feb. 19, 1891.

15 S. B. Harris to J. S. Lane, Feb. 27, 1891.

16 S. B. Harris to W. R. Todd, June 6, 1891.

17 QMCo, 1891 Annual Report, p. 12.

18 S. B. Harris to T. F. Mason, April 17, 1891; S. B. Harris to J. S. Lane, April 29, 1891.

[19] QMCo, 1902 Annual Report, p. 12; Copper Handbook, v. III, 1903, p. 461.

[20] S. B. Harris to Thos F. Mason, Oct. 22, 1892.

[21] S. B. Harris to Thos. F. Mason, Dec. 7, 1892.

[22] S. B. Harris to the Gilbert Paper Co., July 16, 1894. It seems that mechanical stokers were first tried at the stamp mill.

[23] J. L. Harris to A. J. Yungbluth, April 30, 1901.

[24] QMCo, 1891 Annual Report, p. 12; S. B. Harris to T. F. Mason, Aug. 28, 1891.

[25] S. B. Harris to T. F. Mason, Sept. 19, 1891; S. B. Harris to W. R. Todd, Dec 7, 1892; OMCo, 1892 Annual Report, p. 15.

[26] QMCo, 1892 Annual Report, p. 14.

[27] QMCo, 1893 Annual Report, p. 14; 1894 Annual Report, p. 13.

[28] QMCo, 1894 Annual Report, p. 14; 1895 Annual Report, p. 13.

[29] S. B. Harris to T. F. Mason, July 4 and Aug. 22, 1893.

[30] Ibid.

[31] S. B. Harris to T. F. Mason, July 29, 1893.

[32] QMCo, 1894 Annual Report, p. 14.

[33] S. B. Harris to W. R. Todd, Aug. 4, 1894.

[34] QMCo, 1895 Annual Report, p. 14.

[35] S. B. Harris to E. P. Allis Co., Dec. 23, 1893.

[36] Ibid.

[37] S. B. Harris to T. F. Mason, Jan. 9, 1894.

[38] S. B. Harris to T. F. Mason, Dec. 23, 1893 and Jan. 24, 1894.

[39] S. B. Harris to T. F. Mason, Feb. 1, 1894.

[40] S. B. Harris to T. F. Mason, Feb.20, 1894.

[41] QMCo, 1894 Annual Report, p. 14; Engineering News, April 18, 1895, p. 255.

42 S. B. Harris to T. F. Mason, Jan. 17, 1895.

43 S. B. Harris to T. F. Mason, Nov. 30, 1895.

44 S. B. Harris to W. R. Todd, Oct. 10, 1900.

45 QMCo, 1897 Annual Report, p. 12.

46 S. B. Harris to T. F. Mason, March 20, 1897 and May 22, 1898.

47 QMCo, 1897 Annual Report, p. 12.

48 S. B. Harris to W. R. Todd, March 8, 1899.

49 S. B. Harris to T. F. Mason, July 26, 1898; QMCo, 1898 Annual Report, p. 11.

50 Copper Handbook, v. I, 1900, p. 221.

51 S. B. Harris to E. P. Allis Co., June 15, 1898; J. L. Harris to Allis-Chalmers, Sept. 13, 1904.

52 QMCo, 1898 Annual Report, p. 12.

53 S. B. Harris to T. F. Mason, Oct. 6, 1897.

54 Ibid. Also, S. B. Harris to W. R. Todd, March 20, 1899.

55 J. L. Harris to W. R. Todd, March 28 and April 14, 1903.

56 This idea definitely was considered in April, 1903. It may have been considered also in the late 1890s. See J. L. Harris to W. R. Todd, April 14, 1903.

57 QMCo, 1899 Annual Report, p. 11; Copper Handbook, v.I, 1900, p. 221.

58 S. B. Harris to W. R. Todd, Dec. 6, 1899.

59 Copper Handbook, v. I, 1900, p. 222; QMCo, 1899 Annual Report, p. 12.

60 S. B. Harris to W. R. Todd, March 31, 1899.

61 J. L. Harris to W. R. Todd, Aug. 12, 1902.

62 J. L. Harris to W. R. Todd, March 20, 1903.

63 Ibid.

64 J. L. Harris to O. P. Wood, May 3, 1905.

65 Ibid.

66 J. L. Harris to R. A. Swain, Feb. 3, 1905.

67 J. L. Harris to O. P. Hood, March 10 and May 3, 1905.

68 J. L. Harris to (Mining Capt.) Thomas Whittle, May 6, 1905.

69 S. B. Harris to E. P. Allis, Jan. 10, 1904.

70 J. L. Harris to William Tod(d?) Co., June 27, 1905.

71 These numerous improvements are discussed in Copper Handbook v. I, 1900 and in QMCo Annual Reports, 1899 and 1900.

72 QMCo Annual Reports: 1890, p. 10; 1900, p. 11.

73 S. B. Harris to W. Hart Smith, Feb. 18, 1893.

74 Charles O'Connell, HAER Quincy Mine Stamp Mill Report (1978), Table 4, p. 27.

75 O'Connell, Table V, p. 54; QMCo, 1890 Annual Report, p. 9.

76 O'Connell, Ibid.

77

78 S. B. Harris to W. R. Todd, March 2, 1901.

79 J. L. Harris to R. A. Swain, May 28, 1902; T. A. Rickard, Copper Mines of Lake Superior, 1905, p. 64

80 J. L. Harris to Swain, May 28, 1902.

81 Ibid.

82 J. L. Harris to George A. Sonnemann, Dec. 4, 1902; Copper Handbook, v. IV, 1904, p. 605.

83 J. L. Harris to Hendrix & Bolthoff, Nov. 3, 1903; J. L. Harris to J. B. Word, April 7, 1904; J. L. Harris to Word Mfg. Co., Sept. 23, 1904; 1904 Annual Report, p. 12.

84 J. L. Harris to W. M. Gilliland, Aug. 6, 1904; to James Wilcox, Dec. 23, 1904.

85 S. B. Harris to Samuel Brady, Jan. 27, 1900.

86 S. B. Harris to D. D. Scott, April 23, 1901.

87 S. B. Harris to W. R. Todd, March 2, 1901.

88 S. B. Harris to Lake Superior Powder Co., May 2, 1901.

89 Contract, QMCo and Lake Superior Powder Co., July, 1904.

90

91 Quincy came to prefer "moonshine" over "sunshine." Just during the month of April, 1901 the company used 11,7000 pounds of "moonshine." Apparently some candles were still used, too, because Quincy miners preferred "candles to lamps in very close drifts, where the ventilation is poor." See J. L. Harris to Buffalo Refining Co., Jan. 30, 1905; S. B. Harris to D. D. Scott, April 23, 1901; J. L. Harris to E. Schneider & Co., July 20, 1905.

92 S. B. Harris to W. R. Todd, June 19, 1897.

93 J. L. Harris to Sturgeon River Lumber Co., Nov. 26, 1900; to J. G. Kirschen, Feb. 18, 1901.

94 S. B. Harris to T. F. Mason, April 29, 1896.

95 S. B. Harris to W. R. Todd, May 21, 1900.

96 S. B. Harris to W. R. Tood, March 22, 1901.

97 S. B. Harris to W. R. Todd, April 6, 1901.

98 QMCo, 1901 Annual Report, p. 11.

99 S. B. Harris to W. R. Todd, Jan. 3, 1902.

100 Copper Handbook, v. II, 1902, p. 242.

101 QMCo, 1902 Annual Report, p. 12.

102 QMCo, 1903 Annual Report, p. 12.

103 Copper Handbook, v. II, 1902, p. 242.

104 J. L. Harris to J. H. Wilson, Dec. 26, 1903.

105 J. L. Harris to W. R. Todd, June 19, 1902.

106 J. L. Harris to L. B. Sutton, Feb. 15, 1903.

107 J. L. Harris to W. R. Todd, Jan. 17, 1904. The wage cut fostered a strike.

108 J. L. Harris to W. M. Gilliland, Dec. 28, 1903, and to W. R. Todd, Sept. 14, 1903. Quincy's original General Electric motor-generator was located underground in a substaion on the 56th level; in 1907 a new Westinghouse motor-generator replaced the G.E. equipment and was located on the surface.

109 Copper Handbook, v. X, 1910-1911, p. 1444; QMCo, 1917 Annual Report, p. 17.

110 QMCo, 1918 Annual Report, p. 16.

111 J. L. Harris to W. R. Todd, Aug. 27, 1902.

112 QMCo, 1902 Annual Report, p. 12.

113 Copper Handbook, v. IV, 1904, p. 605.

114 QMCo, 1904 Annual Report, p. 12.

115 Rickard, Copper Mines of Lake Superior, p. 67.

116 S. B. Harris to E. P. Allis Co., Dec. 21, 1893.

117 Copper Handbook, v. I, 1900, p. 221.

118 S. B. Harris to T. F. Mason, Jan. 24 and March 10, 1894; QMCo, 1894 Annual Report, p. 12.

119 QMCo 1902 Annual Report, p. 12; J. L. Harris to J. Wilson, Dec. 26, 1903 and to W. R. Todd, Dec. 18, 1902.

120 Rickard, Copper Mines of Lake Superior, p. 63.

121 Ibid., p. 63.

122 QMCo drawings, "Plan of Skip . . . for No. 2 Shaft," Oct., 1892 (with later notes); "8 Ton Skip for Quincy Mine," Oct. 10, 1902.

123 Chas. Lawton to W. R. Todd, May 19, 1922.

124 QMCo 1893 Annual Report, p. 14.

125 QMCo, 1895 Annual Report, p. 14; S. B. Harris to T. F. Mason, July 22, 1895.

126 Copper Handbook, v.II, 1902, p. 244; S. B. Harris to W. R. Todd, Jan. 4, 1893.

127 S. B. Harris to W. R. Todd, Sept. 5, 1895; QMCo, 1895 Annual Report, p. 14.

128 QMCo, 1903 Annual Report, p. 11.

129 Ibid., p. 12; J. L. Harris to W. R. Todd, August 12, 1902.

[130] QMCo, "Lander's Log, No. 6 Shaft," 1905-1908.

[131] J. L. Harris to W. R. Todd, April 8, 1904. In this letter, Harris indicated the need for two water skips at each shaft -- one for each skip road.

[132] S. B. Harris to T. F. Mason, April 4, 1894.

[133] S. B. Harris to T. F. Mason, May 2, 1899.

[134] J. L. Harris to Wm. B. Mather, April 6, 1905.

[135] Ibid.

CHAPTER IV

In 1905 Quincy's directors named Charles L. Lawton to serve as Superintendent (Agent) of the mine. Lawton was a Michigan native, the son of Charles D. Lawton, who once served as the state's Commissioner of Mineral Statistics. Charles L. Lawton graduated with a degree in mechanical engineering from Michigan Agricultural College (now Michigan State University) and then studied at the Michigan College of Mines in Houghton (now Michigan Technological University). Following his education, Lawton had sixteen years of practical experience before coming to Quincy. Most recently he had served at the Dalton & Lark property of the Bingham Consolidated Company in Utah.

The new Superintendent was lauded in an editorial appearing in Hancock's Evening Journal of Nov. 3, 1905. His appointment, the paper noted, was "another instance of where a young Michigan man has forged to the front and by force of merit alone achieved one of the most prominent positions available to men of his calling." The editorial continued:

> At the Quincy Mine, over which Mr. Lawton has just been appointed superintendent, the scale of operations tend constantly to increase. The dominating spirit of the Quincy is its president, William R. Todd, whose amhition is to realize the best possibilities of the mine, and who will not consider his full obligation to the stockholders discharged until this is accomplished.

Lawton's tenure at the mine proved to be as difficult as it was long. From 1905 to 1920 he kept Quincy's dividend streak alive -- carrying it to 53 straight years. But if Quincy's operations had tended "constantly to increase" before Lawton's arrival, they did not do so thereafter. The mine struggled to maintain its annual production level, first achieved in 1901, of 16 to 22.5 million pounds of ingot. The years 1905 to 1920, although sometimes attended by extremely handsome dividends, were times of trouble prosperity. The mine was not growing; it was trying to maintain its position. Much of the difficulty dated to February, 1906, not long after Lawton had assumed his post. It was then that the roof literally fell in on the Quincy Mine.

Quincy had been hollowing out the Pewabic Lode since 1856, yet it had never systematically supported the hanging wall. It had never had to, because the rock was strong and had always stayed put. But the 1870s critic who had written that "it must one day give way" was finally proven right on Feb. 9, 1906, when a series of "air blasts" began that continued intermittently into March.[1] Rock pressures had finally grown great enough to shatter the random poor-rock pillars and limited timbering that held the hangling wall over the foot wall. When the pillars shattered, large portions of the mine caved in, and both the hanging and foot walls moved:

> During the years of the Quincy Mine's life, the system of mining has been back and breast stoping, leaving pillars of poor rock where they occurred . . . . This system practically has been carried down from grass-roots. As depth was gained, the hanging wall became heavier and heavier. When the mine had reached about the forty-seventh level, the pillars commenced to give way at about the fortieth level, causing what is

> termed "air blasts. . . ." As the mine attained greater depth, the point of breaking strain of all the pillars was finally reached, and the great disturbance came. . . . The cause was insufficient pillars and hanging wall supports.[2]

The largest rock falls often occurred in stoped-out areas that had been mined years before. When portions of the mine fell, the collapsing rock compressed the nearby air and shot it through the mine, creating a kind of underground cyclone. Hence the local term for the rock bursts: "air blasts." They were known after their effect, and not their cause.

The air blasts or rock bursts in old, abandoned stopes would have been of small consequence, if the damage had stopped there. But the collapses extended to the shafts, which Quincy had never protected with broad, strong pillars:

> In earlier days. . . , it was the custom to stope out the lode irrespective of the shaft. If the lode was rich in copper, it was stoped out close over or under the shaft; where the shaft was in the lode, the latter was stoped right up to the shaft without leaving shaft pillars. Going through the upper portions of No. 2 and No. 6 shafts, is like going down through open stopes, with practically no pillars left to protect the shafts.[3]

In 1906 the air blasts commencing at the 40th level crushed portions of Shafts 2, 6, and 7, putting them out of commission for as long as ten days. The shafts were the mine's major arteries, and the cessation of hoisting was a severe economic blow. In addition to damaging the shafts and skip roads, the moving hanging and foot walls played havoc with the mine's other major systems. Shifting rock tore up and twisted the tram tracks, severed trolley wires, and shattered the pipe-lines carrying compressed air and water.[4]

No miners lost their lives in the 1906 air blasts, and surprisingly few fatalities accompanied the numerous cave-ins which plagued Quincy for the next 25 years, until it shut down in 1931. But just as the air blasts shattered cast-iron pipes, so did they shatter the labor force's confidence in the mine and in their own safety. The air blasts further exacerbated labor-management problems, which had been on the increase since the late 1890s. The first month-long series of air blasts understandably frightened many underground workers and made them "very timid."[5]

Some were loathe to return to the shaking, rumbling mine, and their caution hampered repair operations and in July led to a brief strike. To better understand this labor disruption, and to identify agitators, Quincy hired the first of several private detective agencies to plant an operator in the mine. No doubt to the great chagrin of management, Quincy's first "spy," from the Thiel Detective Service Company, working underground at No. 7, sided with the disgruntled, fearful miners:

> . . . the operative was put to work shoveling and clearing out the ore in the large rooms which had fallen down on account of insufficient timbering. He states that this is very dangerous work and that both the captains and foreman have said: "Timbering costs money while men do not cost us anything." During the day two pipemen . . . said that the company never put timber into a room in that shaft until after someone had been killed on account of it. . . . Operative states that there are spaces 50 x 75 feet and 75 x 100 feet without any timber; that in some places they have posts from 9 to 14 inches in diameter, but so far apart that they are really no protection. . . . During the day operative and others had to run a number of times in order to escape being struck by falling stone.[6]

The operative, quite likely a neophyte unaccustomed to going underground, may well have overstated the danger. But the air blasts truly belied Quincy's moniker of "Old Reliable."

It was readily apparent that the series of 1906 air blasts was not a one-time phenomenon. As the mine went deeper, higher rock pressures would increase the potential for collapses. The air blasts called for two remedies. There was the older, middle portion of the mine to worry about. Somehow the upper levels -- particularly at the shafts -- had to be strengthened after the fact. At the same time, a new means of exploiting future levels would have to be pursued, to make them safe.

Over more than two decades, Lawton, his Mining Captains, and the company officers in New York would assess the costs and benefits of numerous strategies for checking air blasts. But all assessments were rife with guesswork. The air blasts were fraught with great uncertainties and unknowns. Nobody could ever forecast when and where they might strike, and this inability sometimes led to disastrous results, as Lawton reported to W. R. Todd in 1921:

> The air-blast yesterday morning in the extreme North workings . . . was a comparatively small affair but it caught four Englishmen, two of them not especially seriously injured but two of them had their necks broken and therefore killed. . . . The Mine Inspector was in the same stope two days before. Mr. Desollar (QMCo engineer) was there the day before, and I was also very near there the day before. . . . We considered it safe, but it shows we cannot always tell.[7]

The air blasts presented a perplexing, dangerous and expensive problem of vast proportions. There were no proven and economically feasible solutions readily at hand. Three years after the blasts started, one major Quincy investor complained to another that Lawton "should give us something more than broad generalities and opinions." And after grappling with air blasts for a dozen years, Lawton, expressing some exasperation, wrote to W. Parsons Todd:

> Where can we turn for advice to meet the situation, and in whose theory shall we have more confidence than in our own practical experience? Very few have had the practical experience in deep mining necessary to solve the problem, none under local conditions.[9]

Quincy's decision makers could not tell if the most expensive plans for checking air blasts would be any more effective than minimal safeguards. The general strategy was not to over-react, and not to seek immediate, highly expensive and yet problematical solutions, but to respond with conservative, expeditious remedies. Then they would wait and see what happened, see if the air blasts subsided. Or, if they recurred, see if the damage was any less than the last time. And there was always the hope that the most recent air blast might have brought the hanging wall "home," might have finally brought it to rest. The intermittent nature of the collapses was part of their frustration. The mine managers could be lulled into a false sense of security over a span of several years when no large collapses occurred. But then major air blasts would strike again.

The periodic rock burst beginning in 1906 gradually caused Quincy to change, in numerous ways, its system of exploiting the Pewabic Lode. After the first blasts, when its miners were working just over a mile underground, Quincy finally started to leave stone pillars on both sides of its shafts. These pillars, 50 feet wide, extended from one level all the way down to the next.[10] Even if the ground near a shaft was extremely rich in copper, it was left unmined. Stopers did not work until they were 50 feet out from either side of the shaft. The pillars would not protect the stopes from collapses, but it was hoped they would hold through an air blast, thus protecting the shaft. In the mid-regions of the mine, where the skip roads passed through open stopes, Quincy built timber cribs along the shaft and filled them with poor rock. If the hanging wall started to fall, the crib-work was to partially support it.[11] Quincy took at least three other measures in or around 1906. It started to dump more poor rock in empty stopes as fill, and between the 62nd and 63rd levels it left a large, solid-rock rib or floor pillar, one-hundred feet thick, that ran the length of the mine.[12] If an air-blast started above these levels, the rib pillar would, it was hoped, check its descent. Similarly, on each new level, at the bottom of its stopes, workers laid up rib-work, or walls of broken poor rock.

In 1907 air blasts caused Quincy "very little trouble," and in its Annual Report for that year the company noted that "the measures taken to abate the air-blast condition and disturbances. . . appear to be of a permanent nature and encourage us to view the future with increasing confidence."[13] That confidence continued through 1908, another year of little trouble. But serious falls struck in 1909 that knocked out the No. 2 shaft from the 38th to the 49th level.[14] Again there was a period of relative calm. Air blasts occurred, but without catastrophic losses of personnel, equipment or productivity. Then in March 1914 a number of heavy air blasts caused extensive damage to Shafts 2 and 6. The No. 2

shaft was blocked for 1000 feet below the 40th level (the same portion of the shaft as had been crushed in 1909), and workers were three months in reopenning it.[15] In 1915 air blasts were "more or less numerous throughout the year " and gave "continued trouble and hindrance to the output."[16] In 1916, more blasts crushed the No. 6 shaft from 50 feet above the 49th level down to the 61st level -- a run of some 1200 feet.[17] Working as fast as possible, it again took Quincy three months to clean, repair and retimber the shaft for hoisting.

No count exists for the number of air blasts that occurred between 1906 and 1914, but between 1914 and 1920 Quincy recorded over 400 separate rock bursts.[18] Most caused no damage, and many were so remote and isolated in abandoned parts of the works that their exact locaton was never ascertained. But the effects of the big air blasts between 1906 and 1920 were all to readily felt. Lawton calculated that over this period the company's losses due to air blasts -- including recovery costs and losses of production -- amounted to $4.5 million.[19] Obviously the remedies attempted after the first air blasts had not succeeded. the company made many more changes to its mining system, and yet these too fell short of achieving stability.

Quincy's quandry was somehow to continue to take out as much copper rock as possible, and yet to leave enough material underground to support the hanging wall, or at least to make sure that it would collapse only in harmless areas. To achieve these ends, Quincy in c. 1907 to 1910 apparently experimented with a switch from its traditional advancing system of exploitation to a retreating system. Under the advancing system, stopers worked outward from the shafts until reaching the ends of drifts. Obviously, with this system, the whole length of a drift had to be protected, because until a level was completely stoped out the drift had to serve as the major transportation route for both men and materials. Under the retreating system, the stoping direction was reversed. Miners would first drive a drift to the boundary of the ground served by a given shaft. Then stopers would begin at the end of the drift, and retreat towards the shaft. Fewer pillars, rib-pack or timbers were required, because any cave-ins would occur in worked out areas that no longer had to be passed through.

Fully preparing the mine for the retreating system would have required a reduction of stoping and productive work until such time as numerous long drifts were completed on new levels. In 1907 Quincy drifted almost 25 per cent more than in 1906, and it trebled its shaft-sinking.[20] But the company backed away from the retreating system in the face of the requisite development costs and the temporary loss of production. Lawton apparently had been the one who initiated a switch to retreating, and it was Lawton and surely the New York officers who called the experiment off:

> Two or three years ago, I began more vigorously to urge the retreating system, and even asked for a fund of two hundred and fifty thousand dollars to be set aside to finance the expenditures. We then commenced to increase the development work, and thereby added to the already high cost of producing a ton of copper rock and a pound of copper. Immediately dissatisfaction arose on account of that increased cost; and . . . the

> displeasure wrought by the increased cost per ton of rock naturally led to more or less restriction of that development work.[21]

With high development costs precluding a switch to the retreating system, Quincy turned to less radical means of thwarting the air blasts. The 50-foot shaft pillars adopted in 1906 proved insufficient. To protect the ever-deeper shafts, Quincy increased the pillars to 200 feet wide on each side of its shafts by 1913, and to 225 feet by 1920.[22] According to Lawton, his Mining Captains had originally opposed the pillars as being wasteful; they caused too much good copper rock to be left underground. Yet with all the air blasts Quincy suffered, as Lawton wrote to W. R. Todd in 1919, " it has been proven that the shaft pillars have been the salvation of the mine -- there is no denying it."[23] If longer lengths of the shafts had been crushed in 1909, 1914 and 1916, Quincy may not have been able to effect a recovery.

The rib-work or walls laid along the stope bottoms after 1906 also proved inadequate; they were not as effective as had been hoped in checking damage when the 1909 air blasts struck. Subsequently, the thickness of the walls was doubled to about 20 feet,[24] and Quincy resorted to rib-packs at both the bottoms and tops of stopes.[25] Laborers laid the rib-work dry (without mortar), compacting the poor rock as tightly as possible, so that given a fall, it would not compress or yield unduly:

> . . . ribs of rock packs were built parallel to, above and below the levels. As the ground was stoped these horizontal ribs were made by building poor rock packs about twenty feet in depth along the levels, using poor

> rock broken in drifting, cross-cutting, shaft-sinking plats and chutes. While those above the level were largely filled with poor rock broken in the stopes. . . .[26]

The rib-packs were to allow Quincy to still exploit the copper wherever they found it. Aside from the shaft pillars, no regular pillars would be left in the stoping ground. The copper rock would be removed; the poor-rock packs would take its place. But Lawton was not content with the rib-packs, when used alone. No dry wall, he thought, could be laid so tightly that it would keep the hanging wall from sagging or collapsing during an air blast. At least as early as 1914, Lawton argued for using sand in conjunction with rib-packs to fill the stopes. At least as late as 1918, he still argued, to no avail, the merits of sand-filling.

Because of the interstices between the rocks, the best rib-packs could be expected to shrink 20 percent if the hanging wall started to move.[27] Sand, poored in to fill the voids in the rib pack, would lessen this shrinkage and strengthen the wall. In principle, sand-filling was a simple solution to the problem of holding up the mine's roof. But putting it into practice was another matter entirely. Throughout its history, Quincy had coped with discovering efficient, economical means of hauling material out of the mine; now Lawton was confronted with the problem of how to deliver huge quantities of sand down into the mine. In 1915 Lawton even patented a special skip-dump for unloading descending filled with sand,[28] but he never devised a plan so convincing that the company officers would accept it as being economically feasible.

In 1914, when trying to sell Quincy's President, W. R. Todd, on sand-filling, Lawton was perhaps too honest in evaluating possible ways and means of filling at least the bottom-third of all stopes with sand and rib-packs:

> I have given the matter careful study, obtaining all of the literature which has come to my attention, from all parts of the world; but I must be frank with you and state that I do not assure the plan that I have devised and suggested to you will be successful in its operation. To be successful, it must do the work and do it cheaply, within our reach commercially. I am inclined to believe that it will; however, it has to be installed and tried out in order to demonstrate its possibilities. Still I do not wish to go into it unless I have your most hearty interest, cooperation, and willingness to accept a partial failure in the 29 beginning with prospect of an ultimate success.

Lawton seemed to offer two ways of delivering sand to depths of well over a mile underground. In some mines using sand-filling, including one at the Copper Range, sand pockets near the shaft collars simply discharged into pipes, and the sand flowed down by gravity. But at Quincy, because the lode flattened out with depth, Lawton believed that sand-carrying pipes would not work beneath the 35th level, because the sand would not run freely. So he planned to deliver the sand in descending skips. The details of this scheme are vague today, as they may have been to Lawton then. Sand-filling would have to be a trial-and-error operation:

> I am not aware of any known system that we could install and be assured in the beginning that it would be a success. Therefore, we have to devise a system and work it out entirely by ourselves.

If Lawton was not sure of how to go about sand filling, or sure of its costs, he was sure of the need for it:

> If we are to operate at still greater depths than now, we must devise ways and means whereby we can do so. . . , which means in our mine ever keeping the foot and hanging walls as near their normal position as possible. . . . I do not expect to stop the air

> blasts, but I do hope to very largely prevent the damages they cause in the mine.[30]

In July and August, 1918, Lawton, William Rogers Todd and W. Parsons Todd were still corresponding over the sand-filling issue, and their letters were tinged with acrimony. Lawton wrote W. R. Todd that, "I regret that we have not been able to institute sand filling in the mine. . . ."[31] To which W. Parsons Todd replied:

> We cannot remember you're hav ing at any time presented plans for sand filling that seemed feasible. Sand filling to be successful must practically eliminate the air blasts and at the same time not increase the cost of producing copper very much.[32]

W. Parson Todd's response frustrated Charles Lawton, and again raised the question of who was more competant in deciding important issues at the mine: the local Agent, with his technical experience and training -- or the company directors, with their greater concern for costs and profits? Lawton wrote back to W. Parsons Todd:

> Are you wise in taking the position, in this case, of arbiter? If so, and if you are correct and no remedies (for air blasts) can be applied, then I say frankly that there may not be the best future for the Quincy Mine.[33]

William Rogers Todd concluded this series of letters by writing that, "It . . . seems to us practically useless or out of the question to try to fill up the older part of the mine . . . . With the gradual settling in the older part of the mine we will only have to wait a few years to notice a considerable lessening in the air blasts."[34] W. Rogers Todd also noted that this was no time to disrupt production work "in order to take sand underground," because for the past three years, due to World War I, copper prices had been high. It was time to aggressively seek profits; not time to think defensively about sand filling.

Lawton was of a mind that sand-filling "should make possible the ultimate winning of more copper from the Quincy Mine."[35] They could safely stope out more copper rock underground, as long as it was replaced with sand rib-packs. But without the sand, large blocks of copper-bearing rock would have to be left in place throughout the mine, and not just adjacent to the shafts; Quincy would have to adopt a regular "pillar and stope" system. Quincy had begun experimenting with the pillar and stope method by as early as 1913, and by c.1915 its use was firmly established along new levels.[36] The flurry of air blasts from 1914 to 1916 prompted its adoption and retention.

Under the pillar and stope method, from the shaft outward, on both sides, the first 200 to 225 feet of rock was inviolable, regardless of its richness. The rock stayed to serve as the shaft pillar. Beyond the pillar, miners raised a stope 50 to 100 feet wide that reached all the way from one level up to the next. Then the stopers leap-frogged over the next block of ground along the drift. They left a block intact that was just as wide as the first "raise stope." Then they raised another stope, left another broad pillar, and so on, until reaching the end of the drift.[37] When each stope was raised sufficiently, a rib pack was laid against stull timbers at its base, with the only opennings being the chutes needed for mucking out stamp rock. When each stope broke through to the level above, timbermen put a row of timbers in the stope about 20 feet below the upper drift, and then filled this space with a rib pack.

The pillars, left in what had once been stoping ground, made the mine's new levels more secure, but while the pillar and stope method "won much favor in correcting the hazards due to air blasts, it was marked by a gradual falling off in output per miner and a corresponding increase in costs."[38] The damage from air blasts lightened, but at the expense of leaving much rock bearing copper behind. To win more copper, by 1917-1918 Quincy adopted a modified retreating system. After advancing a level all the way to its boundary, using alternate stopes and pillars, miners started at the boundary and worked back towards the shaft, reducing the pillar sizes as they retreated. Only by trial-and-error could Lawton and the Mining Captains discover how much additional copper could be safely removed in retreating:

> . . . by mining alternate stopes and leaving pillars in advancing from the shafts. . . , we have gotten along very well until we commenced to take or stope out the pillars in retreating. Since then we have been compelled to leave some of the pillars, especially the upper or top portion, on account of the increased danger incurred.[39]

In 1919, Quincy recovered some 60 percent of the rock from the pillars,[40] meaning that on a given level, after advancing and then retreating, miners exploited about 80 percent of the stoping ground, leaving 20 per cent behind as pillars. By 1921, Charles Lawton, in a Dec. 7 report on "Pillar and Stope Mining," noted that it was the copper reaped in advancing that covered the costs of "shaft-sinking, timbering, shaft chutes, winzes and raises, stations, complete cost of drifting and timbering out, cross-cutting, and other opening work; horizontal rib rock filling, all surface construction, taxes, insurance, superintendence, etc." Profits, however, would have to come from the copper recovered by paring down pillars while retreating.

While revamping its means of exploiting each level, Quincy also experimented with the spacing between levels. To partially check the higher costs involved in leaving more copper rock underground -- or in taking less rock from each level -- Quincy tried to reduce its development costs by driving drifts further apart, jumping from 100 to 120 and then to 240 feet between levels.[41] The latter spacing proved too great. Higher stoping costs offset any lower drifting costs, so Quincy settled for levels generally 160 feet apart.[42]

The air blasts, as will be seen later, did not cease when Quincy adopted pillar and stope mining. Although that system much better protected new stopes, it did nothing to remedy the collapses in older portions of the mine. From 1906 to 1920 (and thereafter), air blasts always waited in the wings. And the collapses were not the only problems associated with the mine's great depth -- problems which would only become worse over time. In many ways, from 1906 on, underground conditions were deteriorating, until by 1920 they clearly posed a threat to the mine's survival.

For one thing, the Pewabic Lode was clearly narrowing down. Near the surface it averaged some twelve feet thick, and at places reached eighteen feet. By 1919, its width varied "from less than three to five and possibly six feet. The average copper content is also less. . . ."[43] With each descending level the copper rock changed in another important way:

> As the mine has grown deeper with the years, the rock has become more and more dense, that is harder, thereby being more difficult to drill, requiring more time and thereby cost to drill. Further, the amygdaloid lodes have become narrower, therefore 'tighter' as the miners say, requiring more powder per foot to drive the drifts, more powder for sinking, more powder for stoping, more powder for breaking the rock in every class of the work.[44]

The narrower, harder lode was also flatter, making it more difficult to muck out the stopes, because gravity and free-falling rock could be less and less depended on. And the deeper Quincy got, the more problems it had with unwatering the mine, and the more difficult it became to assure adequate ventilation in all work places, particularly in those stopes far removed from any shafts. Heat -- coupled with poorer ventilation -- also started to become a major concern. The further down the mine went, the hotter it got, making it physically uncomfortable for the laborers, and fretful for managers, who translated heat fatigue into decreased productivity.[45] In 1905 the mine was still relatively comfortable, and except in the worst areas (such as the stopes tributary to the No. 7 shaft), underground temperatures were probably on the low side of the range of 75 to 85 degrees, which the Bureau of Mines would later term "allowable,"[46] as long as there was good air circulation. But by 1920, Quincy's topes were pushing towards 90 degrees and were very uncomfortable.

There was an insidious inverse proportion at work. As men and machinery reached further down, Quincy's problems and its mining costs went up. Lawton and the company officers, through better management and technological change, attempted to mitigate the adverse effects of the air blasts, of a narrower, tighter, flatter and more meagre lode, of higher temperatures, poorer ventilation and more mine water.

In 1907, a year after the first air blast, Quincy moved to upgrade its air drilling machinery. Its complement of drills was apparently old and difficult to keep in repair. Quincy's machine shop was overburdened in making replacement parts for older machines that were no longer commercially available, and the underground force struggled with unreliable equipment. In 1907 Quincy ordered one-hundred new two-man drills, and it put half in operation by the end of the year.[47] No total drill count is available for 1907, but by 1910 Quincy used about 160 rock drills in sinking, drifting and stoping.[48] To effect better use of the new drills underground, Quincy also made its drill-handling system on the surface more efficient. In 1908 the Word drill-sharpening machines, previously located on the southern end of the mine near the No. 7 shaft, were moved to a more central location at the rear of the 1900 blacksmith shop between shafts 6 and 2.[49] The drill-sharpeners shared the building with the fires and machinery for forging and heat-treating the drill stock, and they were right next door to the machine shop where the drilling machines themselves were worked on.

The biggest change in air-drilling technology since its introduction in the 1870s occurred in 1911-1914, when Quincy switched from drills requiring two operators to those requiring but one. In the entire history of the Quincy Mine, the adoption of the one-man drill proved to be the most controversial and disruptive technological change. Both management and the labor force could easily comprehend the mathematics: if Quincy replaced each two-man drill with a one-man drill capable of the same amount of work, then the number of miners could be halved. As a direct result of concluding this computation, Quincy's miners -- along with others similarly threatened across Michigan's copper region -- struck against the company in 1913. The general strike, organized by the Western Federation of Miners, was particularly bitter, violent and prolonged. Michigan's National Guard, camped at the mine locations, attempted to keep peace between the strikers, who hoped to shut the mines down, and the scabs, imported through special recruitment efforts. Quincy avoided a prolonged stoppage, but only by hiring a rag-tag work force none to skillful at mining. Finally, in 1914, the strike ended. The miners lost; the one-man drill held sway.

The older drills took two operators not because they were so complicated or difficult to run, but because they were so bulky. The "Quincy-Rand" two-man drills (perhaps the 100 drills purchased in 1907, which were apparently manufactured by the Rand Drill Company to Quincy specifications), weighed 293 pounds each, yet were deemed lighter-wight than their predecessors.[50] Each required a six-inch mounting post weighing 145 pounds and a 164-pound clamp ring. A fully outfitted Quincy-Rand two-man drill, then, weighed 602 pounds, far more than one man could manipulate.[51] It took two men to set ip up, but one man could then run it virtually alone. The principal duties of the second man were to squirt water into the drill hole (to clear chips for faster cutting and to keep the dust down), to "pound the machine" when it stuck, and to assist in changing drills.

The two-man machines were piston drills. The drill steel was affixed to the front of the machine, connected to the reciprocating piston being driven by compressed air. As the piston moved back and forth, so did the drill steel, which cut the rock by percussion, not by rotary motion. A major determinant of the large size of the drilling machine was the pressure in the compressed air-lines. At Quincy, by the time the air pipes snaked their way over a mile underground and then reached into distant drifts, stopes or cross-cuts, the air pressure was low, usually only about 60 to 65 pounds per square inch. Thus "the piston area of the heavy drilling machine had to be large in order to obtain the necessary power" to drive 1-1/8 solid drill steel to depths of up to eight feet.[53] By boosting the air pressure from 65 to 100 psi, the piston's size could be reduced, and the remainder of the machine could be scaled down accordingly. In 1911 Quincy ordered a cross-compound, steam-powered, single-stage compressor that could take air from the extant machine at No. 6 and recompress it to 100 psi.[54] The machine was readied in 1912, and at the same time Quincy had to replace many of its old pipelines with stronger new ones. In some areas it also replaced 7-inch pipes with 10-12 inch pipes, both to meet increased demand and to decrease friction losses in the pipes. With high pressure air now available, Quincy searched out a true-one-man machine to take advantage of it.

Between 1911 and 1913, the company tried out a number of different machines. While it is not possible to note just how many of each type were tried, or when they were purchased, Quincy extensively tested at least five different drills or jackhammers, and perhaps looked at as many as 12 to 14.[55] These weighed from a low of 29 pounds (for a small jackhammer) to a high of nearly 160 pounds. All the machines weighed considerably less than the 293 pound drill they would seek to replace, and their posts and clamps (if any were needed) were also significantly lighter, by some 50 to 75 pounds each.[56]

Ideally, Quincy wanted a machine light enough that one man could easily carry the drill up into a stope, as well as its post and clamp. Then he had to be able to quickly assemble and set-up the components. The desired machine would also have an automatic water feed to wash chips out the hole, allay the dust, and help prevent stuck drills. Finally, it would have to perform as well, if not better, than the old two-man drills.

Quincy tested the smaller drills against each other and against the standard two-man drills. A number of drills tried in 1912-1913 proved inadequate, often because they were really too big for one man to handle, or because they lacked the feature of an automatic water feed. Some of the large "one-man" machines were piston drills; like the old two-man machines, they held the drill in a chuck and reciprocated it it.[57] Quincy had better luck with the "hammer" drills. These, of course, still had an internal piston reciprocated by compressed air, but the drill steel was not firmly bolted to the end of the machine in a chuck; instead it was carried loosely in a sleeve or collar. The drill steel was not reciprocated or returned after each blow. It was more simply hammered in.

In one Quincy document ("The Cost of Producing Copper . . .

after March 1st, 1913 Should Be Less Regardless of the Mine's Increasing Depth"), the blame for the 1913 strike is partly laid on the earliest one-man drills, which were actually too heavy for a single operator, and thus increased the lone miner's burden. But the cause of the strike lay more honestly with the successful small jackhammers and the 90-pound Leyner-Ingersoll one-man drills. These were the ones which proved the effectiveness of smaller machines, and which routed two-man drills from the mine, while paving the way for other kinds of one-man equipment. On Nov. 7, 1913, Quincy's Chief Engineer wrote Charles Lawton that the "Leyner-Ingersoll in unquestionably a one-man machine, and should meet with popular favor with all miners." This was a naive belief , for labor's rejection of the one-man drill was not based on the expectation of increased toil for the individual man, but on the recognition of the threat of a halving of the number of miners -- which was just about what happened.

Quincy's 1913 Annual Report noted:

> One recently improved type of machine has especially proven to be of a superior kind. It weighs but ninety pound- -- its mountings weigh one-hundred-twenty-six pounds -- and is adapted to all rock-drilling to an eight-foot depth of hole; with it, one man can easily drill more linear feet of holes in a given time in any position, than can two men drill with the old three hundred pound machine and its more than three-hundred pound mountings. Miners can raise not objections whatever to the little machine, which meets all criticism, is dustless (has water injection), and highly efficient. The first machine manufactured has been thoroughly tried out in the mine for ten weeks, and five machines for one month. . . . Upon the strength of these trials, we have ordered one-hundred of the machines for February(1914) delivery. 58

What the report did not say was that 100 new machines meant 100 fewer miners, without any sacrifice of productivity. Quincy had obtained its first 90-pound "Baby Leyner" on October 25, 1913, and the second shipment of five arrived on December 12, 1913. By April 20, 1914, 106 Baby Leyners worked in the mine, along with some 105 one-man, mounted, Ingersoll-Rand jackhammers.[59] From 1914 up through and beyond 1920, these two machines would predominate in the mine; only small numbers of any other drills were used.[60] Each Leyner cost about $234; each jackhammer about $140.[61] The two-man-drill was virtually gone, and Daniel Smith, Quincy's Auditor, wrote W. R. Todd on May 30, 1914, that, "It is expected that one miner will do the work approximately of two."

Quincy tested the economic and technological effectiveness of the one-man drills in ways unheard of at the mine in the 19th century. New management tools had taken root, and their use at Quincy would spread until by the 1920s, when the company was in severe economic trouble, it seemed that Charles Lawton did little else but cost out, time and time again, every type of work done at the mine.

When the first Baby Leyner drills were tried, their effectiveness was measured rather grossly by merely noting how many feet they could drill per 8 hour shift:

> Yesterday (Nov. 6, 1913), I inspected the working place; and, at the time of my visit, the new (Leyner) machine, in the hands of one man, had drilled in the drift ten holes (seven five-foot holes and three two-foot holes), while the large two-man machine had a total of nine holes (seven five-foot and two short holes). A record of fifteen holes, totalling a distance of sixty-three feet, has been made by the new machine under

> ordinary conditions. . . . Captain Maunders tells me that one man can easily drill fifty feet per shift, as against forty to forty-five feet now being drilled by machines operated by two men; and with less effort, as the new machine does all the work.[62]

Reports such as this prompted Quincy to invest nearly $25,000 on Baby Leyner rock drills. As soon as a hundred of them were on hand, their performance was scrutinized more closely, to see if expected benefits were actually being reaped. In mid-1914 Quincy's President, W. R. Todd, requested that the company's Auditor make a study "into the reason why the One Man Drills do not appear to reduce the mining costs."[63] Daniel C. Smith went into the mine to see the drills at work and interviewed Lawton and all the Mining Captains. He noted that:

> Some miners have already done so well in drifting as to show that this (the achievement of having one man do the work of two) is practical. As a whole, the miners are relatively green, and unfamiliar especially with the 'one-man drill.' The efficiency of these drills is only just beginning to show.[64]

Smith then documented his opinion by tabulating drifting costs from 1908 through April, 1914. From 1908 until February, 1914, the total cost of drifting a foot varied from a low of $6.033 to a high of $6.577. In March 1914 the effects of the one-man drills began to be felt, as the cost dropped to $5.498, and in April it fell further to $4.790. The labor component of the total drifting cost also fell significantly: from $4.585 in February, 1914 (a figure close to the average labor cost for the proceeding 6 years) to $3.680 in March and $2.996 in April. By April, 1914 the average miner (drilling alone) drifted 28.75 feet per month, and if April had had the usual 26 working days (instead of 25), that figure would have been nearly 30 feet. In 1908 through 1912, the average (drilling with a partner) drifted only 17. 685 feet per month. Smith's figures showed that early in their use, two one-man drills fell somewhat short of doing twice the work of one two-man machine. While in use two shifts per day, each two-man drill from 1908 through 1912 drifted an average of 70 feet per month; the April, 1914 performance of the one-man drills demonstrated that two could be expected to drift a total of 120 feet. Still, there was the promise that the desired doubling could be achieved, or even surpassed, because a few of the one-man drills, in the hands of highly skilled miners, had hit totals of 72 to 80 feet.[65]

Such analysis did not stop with Smith's report to Todd. In November 1914 Quincy conducted three week-long time studies of three different miners using one-man drills.[66] Each miner was observed by "a man from the office," who carefully noted when the miner entered the drift; when he stopped drilling; when he blasted holes; how long he took for lunch; the aggregate length of holes drilled; the percentage of working time spent drilling; and any special problems encountered, such as broken or stuck drills, or a lack of drill steel. The study showed that the three men operated their drills from 40.6 to 45 percent of the entire shift, and it pointed out that the major obstacle to increasing this time (and hence productivity) was the lack of an adequate underground supply of sharp drills of the right bit, length, and gauge.[67]

From 1908 through 1912, two men operating a single drill accounted for an average of 14.1 tons of copper rock per shift. From 1914 through 1918, each miner on a one-man machine averaged 13.2 tons by himself.[68] Quincy, from 1914 on, carefully garnered such

such statistics, for two reasons. First, they wanted to monitor costs and productivity, isolate problem areas, and achieve new efficiencies wherever possible. And secondly, the company wanted impressive statistics on hand to answer any and all critics, both within and outside the company. In an important way, the generation of more and more data regarding Quincy's productivity and economic condition was highly defensive. Lawton used figures to defend his moves to inquisitive, sometimes very critical, company officers in New York. And the officers could use favorable figures to rebut any outside charges that Quincy was an old, unsound mine following an ever-narrower lode to uneconomical depths.

Statistics, judiciously applied, could improve the appearance of any situation. Instead of bemoaning the decreasing width of the Pewabic Lode, Quincy looked on the bright side and trumpeted the savings (calculated at some $420,000 per year) involved in using the smaller one-man drills in stopes purposefully made as narrow as possible -- stopes which declined in their average width from 7.14 feet in 1912 to 5.96 feet in 1920:[69]

> The light one-man drilling machine has made it possible to confine the miners' operation of a machine in a smaller space, in this case to a narrower width of lode. The two-man machine required a stope at least 6-feet wide in which to work, while the one-man machine can comfortably be operated in a stope 3-feet wide. This has made it possible to confine the stoping, the breaking of the lode, to the width as it occurs in the mine, thereby breaking no superfluous poor rock, simply to gain only space in which to work, thus preventing the poor rock from becoming mixed with the copper rock, reducing the latter's tenor, adding to the cost of handling, transportation, and stamping, together with increased losses of copper in stamp mill tailings on account of the copper that it associates with and drags through the mill. The ability to mine the narrow

> stopes also lessens the cost of level rock packs by requiring less timber in stulls and less poor rock.[70]

The small, one-man machines could drill nearly as fast as their larger predecessors due not only to increased air pressure, but to a decrease in the size of drill steels. The two-man machines drove 1-$^{1}/_{8}$ inch, solid drill steel; the one-man machines drove $^{7}/_{8}$th inch hexagonal drill steel, which was hollow so water could be carried through the center.[71]

Because of the smaller blast holes, it seemingly would have been necessary for Quincy to go to a higher explosive in order to break as much rock as before. In 1914, Quincy's auditor wrote that Mining Captain Kendall had said "as the holes are smaller a higher explosive should be used."[72] But Quincy did not go to an explosive stronger than its traditional 40% powder; in fact, some evidence suggests that in 1914 it actually went to a weaker powder of 30 percent.[73]

This change may have been made possible by the small size of the drills. The one-man machines did not have to carve out poor rock just to make room for themselves, so in a given shift miners could drive more holes, closer together, into the lode itself. Consequently the individual blasts did not have to be as powerful. And without question, the lesser explosive was cheaper; its reduced cost perhaps offset any reduction in effectiveness.

Quincy may also have eschewed changing to a higher explosive because of concerns over more labor trouble. In 1912, not long before the advent of the one-man drill, the company Agent and the President clashed once again over the proper explosive to use.

From his arrival in 1905 up to 1912, Charles Lawton had twice changed the type of explosive used by Quincy. First he switched from nitro-glycerine dynamite to ammonia powder, and then, around 1910, he changed to gelatine powder throughout the mine.[74] In May 1912, Lawton received the following letter from W. R. Todd:

> You will please inform me what effort you are making to (re)introduce Ammonia powder in use at the mine, in place of Gelatine. I think it should be done at once . . . -- don't order any more Gelatine and as quickly as possible discontinue its use in South Quincy.[75]

In response, Lawton wrote to Todd:

> I trust it will be agreeable to you to assume any and all responsibilities than may arise on account of the change. I have never had any fear of changing to better powders; but, in this case, I have great fears, especially during such chaotic labor times.[76]

Quincy's President, dismayed by the Agent's recalcitrance, next charged that Lawton's introduction of gelatine powder had "caused a loss to the company of at least $50,000, without any corresponding benefit."[77] Lawton, on his part, claimed a savings of $50,000. He then admitted that he had been contemplating a switch back to ammonia powder, prior to Todd's first letter on the subject:

> We have been using the gelatine powder throughout the mine now for over two years, and I had supposed . . . you were satisfied...; and yet I have been planning from time to time to make the change to low-freezing ammonia powder, as per your instructions, but each time I would come to the point of doing it, I would be fearful of some labor disturbances underground. As you know, we never make a change in powder without having more or less labor disturbance.[78]

No further correspondence on this issue survives, and the final decision made on the powder question is in doubt. Yet it is clear that by this period Quincy's labor force -- far more volatile than in the 19th century -- exerted a stronger influence on any changes made by the company.

One other change related to drilling and blasting should be noted before passing on to other aspects of the mine's technology. Quincy was still finding considerable mass copper that had to be cut up underground. For years -- apparently into the 20th century -- this was done by hand with chisels and sledges. At some point prior to 1914, Quincy mechanized this work. Machine inventories for 1914 and 1918 lest six to ten "copper cutters."[79] The cutters are not described in Quincy's own records. A 1915 source speaks of "pneumatic chisels,"[80] but if the copper cutters were similar to those used throughout the district by the 1920s, they may have been air-operated twist drills. Miners drilled one-inch holes close together across a piece of mass, charged them with dynamite, and blew the mass apart.[81]

Numerous other changes occurred underground between 1905 and 1920. By 1905, an outsider noted that the "main difficulty" underground, because of the flattening dip of the lode, was that rock broken in the stopes did not descend freely to the drifts. Mucking out the stopes became more labor intensive:

> Waste rock is built up into walls, which reach from the foot-wall to the hanging, and, in these 'pack walls' openings are left for chutes or passes, at intervals of 40 to 50 feet. When the lode is broken by a blast, only the big pieces roll down; the remainder is pulled or hooked down until it lands on a platform or 'sollar' on

> the footwall side of the level, whence it is shoveled into the cars.[82]

Near the surface the dip of the Pewabic Lode was 54 degrees. By 1909 the dip had declined to 36 to 38 degrees at depths of 5650 to 6170 feet.[83] As Quincy went still deeper, the stopes continued, however gradually, to get flatter. But in 1918 Quincy finally announced a remedy.

> The gradual flattening of the lode with depth has increased the difficulty of handling the rock from the flat foot-walls of the stopes into the chutes and to the levels below, and made it important to design a mechanical power scraper to do this work. . . . Several of these scrapers have been built, together with specially designed air hoists, and are now being successfully operated.[84]

The scraper blades were attached to wire ropes that pulled the scraper down, to claw out the stope, or returned it to the top for more work. The wire ropes wound and unwound from the air-driven hoist placed near the bottom of the stope. Quincy claimed that the power scraper cut the cost of mucking out rock by one-half, with all the savings coming from reduced labor costs: "The scraper working in a stope, operated by three men, will do as much work per shift as ten men shoveling in the same stope. . . ."[85]

In the same year it introduced stope scrapers, Quincy also experimented with an unspecified kind of "power shovel" underground. The 1918 Annual Report noted "encouraging results," and said that this piece of equipment was one of "the great needs of our times, and will undoubtedly be perfected in the near future."[86] But it was not perfected. This shovel, apparently, was intended for use in the ends of drifts and cross-cuts, where it was supposed to "speed the driving of developments and openings."[87] Between 1918 and

1925 Quincy seems to have designed and built at least two "power loading shovels" -- but neither worked well enough to warrant its general introduction into the mine. In lieu of the power shovels, Quincy adopted "level scrapers," which, like the stope scrapers, were dragged across the floor of a drift to clear it.[88]

In the small, $6^1/_2$ foot by 6 foot drifts, there was room for only two laborers to clear rock, and in one shift they could clear away the rock broken only by one drilling machine. The level scraper required the same two men, but they could clear the products of up to three drills.[89] Still, mucking out drifts must have remained a problem, since Quincy continued to search for a workable power shovel, and in 1925 it was still redesigning the scrapers, perhaps in an attempt to arrive at an arrangement whereby the scrapers deposited the rock directly into a tramcar.[90] For unexplained reasons, Quincy never went to underground conveyor systems for mucking out rock and putting it into cars until 1930, at which time the conveyor was credited with increasing by up to 100 per cent the tonnage handled by trammers.[91]

In 1901 Quincy had mechanized rock-tramming along long drifts by introducing electric locomotives underground. As noted earlier, the company regularly extended its electric haulage system throughout the 1905 to 1920 period, installing it on new levels and adding locomotives. In 1909 Quincy greatly increased the benefits reaped from electric locomotives by making a very simple, yet important change to its tramcars.

Under the original electric haulage system, a locomotive pulled a train of three to five end-dumping cars. When the "train" reached the mouth of the underground storage bin for copper rock, three men disconnected the cars, ran them onto a small turntable, rotated them ninety degrees, and then, using a block and tackle and the locomotive for power, tilted the cars for dumping.[92] In 1903 Quincy had fiddled with its turntables and the "necessary accessories" for dumping the tramcars, and J. L. Harris wrote to W. R. Todd, "We cannot conceive of any system that is more rapid or more economical for this work."[93] But in 1909 Quincy's engineering department devised a means of avoiding the uncoupling and turning of cars altogether: the automatic side-dumping car.[94]

This innovation was simple in both theory and practice. One side of the new car was hinged at the top, so it could swing open. From the other side of the car protruded a "follower." Opposite the entrance of a storage bin, Quincy carpenters built a hill -- really a stationary, cam-like device that gently rose on one side and fell on the other. As the motor slowly drove past the storage bin, the follower on the car rode up the hill, causing the car body, on a pivot, to tilt over, while the car's wheels remained on the tracks. As the car body swung over, the side-door opened and the rock fell into a chute. The process required no stoppage of the train; no uncoupling of the cars (they dumped one after the other); and no laborers at the storage bin. The side-dumpers proved "satisfactory and efficient," and by 1912 thirty-three were in use throughout the mine, and all the old end-dumpers were replaced as they wore out.[95] Quincy patented the design of these cars, which had a $2^3/_4$-ton capacity.

Underground, the facilities for hoisting remained relatively unchanged. The fillers, landers and engineers still communicated by the Armstrong pull-rope and bell system. The 8-ton skips introduced prior to 1905 remained in use, yet due to the difficulty of filling them to capacity, their actual load up to 1917 averaged about 7 tons. To augment their capacity during the war years, a slight addition was made to the top of the skips to reach $7^1/_4$ tons.[96] The skip gates, that dropped the skip's rear wheels and tipped the skips closer to vertical so they would be easier to fill, also continued unchanged until 1920 at the hoisting stations or plats. Required improvements to the mechanism, however, had been noted by 1915, and had been deferred only because of the desire to lose no production time during the boom market years of World War I. The original design of the skip-gates:

> caused the loss of more or less time as they required that the skip be lowered into them slowly and carefully in order to prevent the sudden jar to to the skip and the breakage of the axles, which often occurred.[97]

Because of the air-blasts, Quincy was using more of its poor rock underground in rib-packs. Still, some provisions were made for getting excess poor rock out of the way without hoisting it all to the surface. An underground skip-dump, designed about 1913, was installed at the No. 6 shaft about 1915 and at the No. 8 shaft in 1920.[98] The motivation for leaving this rock underground was clear:

> Every time a skip loaded with 'poor rock' was hoisted to the surface it not only represented the loss of time which could be used to greater advantage, but it also required handling through the shaft-rockhouses,

loading into railroad cars, hauling away to a dump and unloading; the material at is final destination serving no useful purpose.[99]

The skip dump was a special section of track installed in conjunction with the normal skip road. The filler working at a hoisting station could simply pull a lever, which would divert the rising skip onto the skip-dump tracks some 500 to 1000 feet above. The skip tilted and dumped into a storage pocket cut in the footwall; the pocket was arranged so that if poor rock were later needed for rib-work or fill, it could be drawn off the bottome through a chute into side-dumping tramcars, which would deliver the rock to where it was needed.[100]

By at least 1914, Quincy also acquired a managerial tool that served as part of its hoisting system.[101] The Johnson Recorder for Mines, patented in 1909, was installed at the surface alongside whichever hoist was being studied, but it recorded what was happening underground. This machine charted the motion of skips from 7 a.m. to 7 pm., (or the reverse, if the night shift were on). It displayed the vertical motion of-skips; where they stopped; and how long each trip or stop lasted. By studying the chart, mine officers could look for patterns of inefficiency or wasted time. In 1920, for example, Quincy's Master Mechanic and one of the Mining Captains disputed the causes of less-than-expected hoisting totals at the No. 2 shaft. The Mining Captain blamed the hoist engineer for not pulling away fast enough from loading stations. The Master Mechanic blamed it on slow loading chute operators underground. The Johnson hoist recorder was attached to the No. 2 engine, and it gave "clear evidence that the responsibility is on Captain Maunder's shoulders, that is, underground, mainly with the chute men. . . ."[102] Charles Lawton thought that by speeding them up, No. 2 shaft should be able to hoist 8 to 10 more skips in 24 hours.

Miners and underground workers continued to ride in and out of the mine on man-cars like those first introduced in 1892. For the better part of the 1905 to 1920 period, bailing skips still served as the predominant means of unwatering the mine. But the mine was collecting more water. (The company raised almost twice as much water in 1920 as it had raised in 1913: 68 million gallons as compared with 38 million gallons.)[103] Part of this increase was due to workings north of the No. 8 shaft which had penetrated a particularly wet area. To augment its unwatering capabilities, Quincy took two new steps in 1916.[104] In the lower reaches it installed electric pumps. In the upper reaches, specifically along the sixth level, all the way from the northern workings of the old Franklin Mine southward to No. 7, it built a concrete gutter. This gutter replaced an older, "indifferent" water runway, made of timber and clay, which had proved "very insufficient in preventing the surface waters. . . from percolating down into the lower levels or bottom of the mine."[105] The concrete gutter, leading out the East Adit and draining into Portage Lake, shut off "all of the surface water which formerly drained from the top levels of the mine."[106] Following this changes, Quincy claimed that the use of electric pumps cut the cost of raising water from $.44 per 1000 gallons in 1913 to $.14 in 1920, and that the concrete gutter captured 45 million gallons in 1920 that otherwise would have had to have been raised.[107] (Although the electric pumps were an important part of the unwatering system at this time, they by no means worked alone; bailing skips remained in use.)

In 1920, Quincy was not quite ready to cope with growing underground temperature and ventilation provlems. By a few years later, it would begin adding electric fans underground to carry, through 16 or 12-inch flexible tubing, "fresh air close to the working places in the deeper parts of the mine."[108] Twelve such units operated by 1926. But in 1920, company policy was still to play down any problems:

> The temperature of the rock in the bottom of the mine, and accordingly of the atmosphere, is higher than in the upper portions of the mine. Both have increased as the mine has gone deeper. This factor was taken up about eight or ten years ago but since that time nothing further has been done as the temperature of the atmosphere has not been of sufficient moment to be taken up and considered seriously. No doubt as the mine grows deeper it will become a factor that will have to receive attention, but we have confidence that when that time comes, this feature will be met and overcome as have many other deep mining factors before it.[109]

Quincy perhaps was not quite ready to cope fully with the problem, but it existed nevertheless, and had existed since near the turn of the century. By 1902 the company realized it had a particular problem with the No. 7 shaft and its tributory workings. No 7 at first had been a downcast shaft; but by 1902 it had switched to being upcast and this upset the flow of fresh air through that part of the mine. J. L. Harris wrote that "the accumulation of foul air in places has hampered the miners and underground laborers, in general, to quite an extent."[110] To remedy the problem, Quincy attempted mechanical means of reversing the air-flow at No. 7. It installed a 9-foot fan over the collar of the old man-engine shaft that was capable of extracting 70,000 cubic feet of air per minute.[111] Harris reported to W. R. Todd, early in 1903, that the fan materially aided ventilation in shafts 2 and 4, but that No. 7, "however, still remains upcast."[112]

By 1904 Quincy was recording temperatures of up to at least 80 degrees along parts of its 60th level.[113] As soon as Quincy began planting detective agency operatives into the mine in 1906, these operatives reported that one of the miners' chief complaints was high underground temperatures.[114] So the ventilation and temperature problem surely existed, and it only worsened with greater depth. By 1921, near the No. 2 shaft along the 81st level, Quincy recorded a temperature of 89 degrees.[115] Quincy either had thought of no remedy (such as the electric fans it soon installed), or it simply chose not to invest in any remedy until such time as a drop in productivity due to higher temperatures and poorer air was clearly felt.

One last change in the underground technology should be noted before moving to the surface. In 1912 to 1914, Quincy switched from parafin-based fuels to calcium carbide for miners' lamps.[116] A small amount of water added to the carbide produced the acetylene gas which was burned. In all likelihood, Quincy received its carbide from the new Union Carbide plant located at Sault Ste. Marie, Michigan.[117] To keep the cost of its consumable supplies low, the company carefully monitored the amount of carbide doled out to each miner:

> During the year, individual carbide-retainers for mine lighting were obtained, holding just enough carbide for a shift's work. These cans are filled during the

> day, and at the beginning of each shift the miners exchange their empty cans for the filled ones. Each miner is thus provided with the exact amount of carbide needed for light during the shift's work, and waste is prevented.[118]

In the same manner, Quincy carefully doled out a day's worth of machine oil in small cans to air-drill runners.

On the surface, Quincy made several important improvements to its plant, yet nothing like the building boom of 1890 to 1900 recurred. Most of the satellite support facilities constructed during the boom sufficed with minor modifications through 1920 and beyond. It is important to re-emphasize that Quincy did no augment its production between 1905 and 1920. This was not a growth period, but a holding period, where Quincy maintained the production plateau of roughly 20 million pounds of ingot. Any additions to the physical plant and operations in one area tended to be offset by deletions in another. Before looking at any specific changes in the surface plant or the systems there, it is appropriate to take a more general look at the mine's condition, emphasizing the development of the various shafts.

From the early 1870s to 1892, Quincy hoisted rock only from shafts 2 and 4. Then, between 1892 and 1901, while retaining those two shafts, Quincy opened Nos. 6, 7, and 8. Between 1905 and 1920, the company closed No. 4; opened and closed a short-lived No. 9; and the No. 7 shaft bottomed out, or reached the edge of Quincy's property. The progress of all Quincy shafts operating from 1910 to 1920 is shown in Table 4.1

The No. 4 shaft and its drifts leading to the south had proved very valuable in providing underground access to that territory when

TABLE 4.1

Quincy Shaft Data, 1909 to 1920

Lowest levels worked for each year, and depths of those levels measured on the incline. No. 4 Shaft excluded (closed 1909).

Year	Shaft Numbers 2	6	7	8	9
1909	66th 5851'	64th 5650'	68th 6170'	50th 4125'	4th 597'
1910	67th 5965	65th 5762	70th 6390	51st 4252	6th 1053
1911	68th 6083	67th 5986	71st 6497	54th 4529	10th 1439
1912	70th 6322	67th 5986	same	56th 4739	20th 2634
1913	72nd 6563	69th 6209	same	57th 4834	same
1914	73rd 6686	71st 6409	same	59th 5028	same
1915	75th 6928	73rd 6622	same	63rd 5373	same
1916	76th 7049	73rd 6622	same	65th 5606	same
1917	78th 7289	75th 6865	same	67th 5816	same
1918	79th 7404	76th 6988	same	69th 5992	same
1919	81st 7649	78th 7213	same	71st 6197	same
1920	82nd 7769	78th 7213	same	73rd 6393	same

NOTE: Maximum shaft depth could reach 0 to 200 feet below lowest working level.

SOURCE: QMCo card file, "Data on Quincy Shafts."

Quincy both sank and raised the No. 7 shaft. But as soon as the new shaft opened, it seemed to make the old No. 4 shaft expendable, particularly because of electric haulage. Situated as it was, between Nos. 2 and 7, No. 4 did not penetrate any ground that could not be worked from either of its neighbors. By at least as early as 1901-1902, when both No. 2 and No. 7 (at 4900 and 4700-foot depths respectively)[119] were below the 4300-foot deep No. 4, J. L. Harris as studying "the feasibility of abandoning No. 4 shaft," and he reported his findings to W. R. Todd.[120] Actually, this move may have been anticipated even 6 or 7 years earlier. During the building boom of the 1890s, when Quincy installed the impressive physical plant at No. 6 and then greatly upgraded its plant at No. 2, it largely passed over No. 4. In 1895 Quincy built a new shaft-house at No. 4, but it did not construct a more expensive shaft-rockhouse there. Rock from No. 4 was still trammed south along the surface to the old rockhouse. Also, Quincy installed no new hoist at No. 4.

If Quincy had a plan in the mid- or late-1890s to scuttle the No. 4 shaft soon after opening No. 7, it shelved the idea, at least for a while. The mine Agent, Harris, noted in 1902 that the chief liabilities of the No. 4 operation involved its separate rock-house. The structure was not only an "eye-sore" and a fire risk, but "the rock treated costs about twice as much per ton as in No. 6, No. 2 and No. 7."[121] Still, Harris concluded that No. 4 should remain in operation, and he recited a number of advantages to Todd.

Quincy was having all it could do to hoist enough rock at the mine to keep both the 1890 and 1900 stamp mills at Torch Lake operating to capacity. No. 4 accounted for 20 per cent of the total rock hoisted by Quincy's five shafts, and that quantity would be hard to make up if No. 4 were shut down. Also, if No. 4 closed, other shafts would be more tied up with carrying men and supplies down into the mine, and in hoisting water out. One-third of the men and well over half of the water raised from the mine went through No. 4. In a neat statistical summary, Harris demonstrated the value of No. 4, and proved the point, at least to his satisfaction, if not to Todd's, that it was still a vital shaft.[122]

TABLE 4.2

Percentage of skips (rock skips, man-cars and bailing skips) hoisted in 1901, by shafts

	Stamp Rock	Poor Rock	Men	Water
No. 2	24%	18%	21%	4%
No. 4	20	5	34	65
No. 6	25	7	26	27
No. 7	26	21	16	--
No. 8	4	48	2	4
	99%	99%	99%	100%

Todd agreed to give No. 4 a short lease on life, but only until all available stoping ground near the shaft was exhausted. Quincy's 1903 Annual Report noted that the company was preparing to abandon No. 4,[123] as did the 1904 edition of the Copper Handbook.[124]

However, in 1904 the tenor of the rock on the West Branch of the Pewabic Lode greatly improved near No. 4, and the company announced that "it will not be advisable, from present indications, to discontinue work there, as mentioned in previous report, for several years."[125] Consequently, Quincy did not abandon the No. 4 shaft until 1909.[126] With the cessation of hoisting at No. 4, Quincy over time demolished parts of its physical plant, such as the rock-house (taken down in 1909) and the shaft-house (demolished c. 1913). Other parts, such as No. 4's boiler and compressor facilities, remained in use, or at least were kept on stand-by duty.

The closing of No. 4, one of the mine's earliest shafts, nearly coincided with the opening of No. 9, the last new shaft Quincy would sink. Located on ground first exploited by the Pontiac Mine (and purchased by Quincy in 1896), No. 9 was notable in two regards. First, it was far-removed from the rest of the mine. No. 9 stood 2,700 feet north of No. 8, the closest Quincy shaft, and 10,000 feet north of No. 7, the furthest away. Secondly, the No. 9 shaft was an utter failure.

Without question, the Pontiac or No. 9 shaft-sinking was an exploratory venture. Quincy installed a most modest physical plant, just enough equipment to test the lode out in its northern reaches. Quincy started sinking No. 9 in the footwall of the lode in 1908, with the aid of temporary equipment -- a duplex 16" by 20" Nordberg single hoist (a two-cylinder engine that hoisted but one skip) and a 125 h.p. Burt boiler.[127] By 1909 a small timber shaft-rockhouse stood over the shaft, but it was nothing like those structures

Quincy had erected over its proven shafts, and it contained but a single 24" x 18" rockcrusher. Quincy also added a change house and another boiler[128] and in 1913 it moved the 32" x 72" Nordberg engine with a conical drum and a 5000-foot rope capacity from No. 8 to No. 9.[129] This last addition was rendered necessary by the fact that Quincy speeded the development of No. 9, pushing it rapidly to depth to see if the tenor of the rock improved.

Table 4.1 shows that between 1908 and the end of 1912, Quincy sank No. 9 2634 feet, or down to the 20th level, where it holed the shaft to a long drift coming northward from No. 8. Nearly one-half of the total sinking -- 1200 feet -- had been completed in 1912 alone. In that year, Quincy sank No. 9 100 feet per month, while it sank its established shafts only 100 to 200 feet per year. But that was the last shaft-sinking to go on at No. 9. In 1913 Quincy permanently timbered down to the 14th level, apparently putting in the first of an expected two skip roads, and the company seemed ready to exploit the ground seriously.[130] But by the middle of the year Quincy ceased operations at No. 9 altogether, and it never started them up again.

In its 1914 Annual Report, Quincy notes that No. 9 was abandoned for the sake of economy; keeping it open would have been an expense yielding no income.[131] Quincy decided that profitable quantities of copper rock could not be taken consistently from No. 9. Nevertheless, the abandonment is curious since it followed so closely the work of timbering and skip-tracking the shaft. Other circumstances contributed to the closure.

The cessation of work at No. 9 coincided with the strike. The militant strikers made it difficult for Quincy to keep its shafts open, and the remoteness of No. 9 made it an "outpost" more simply surrendered than defended.[132] Also, the higher copper prices of the WWI period and the attendant profitability may have caused Quincy to skew its efforts towards maximizing copper output from established shafts, rather than sinking labor and money into developing a new one.

No. 9 definitely contained copper, but the Pewabic Lode there was marginal, and the development cost were too high to promise adequate returns. And after the war, the declining copper market and Quincy's declining fortunes in general worked against a reopening of No. 9. In 1920, the Mine Superintendent, Lawton, was ready to sell off No. 9's hoist to the Seneca Mine.[133] Any copper coming from Quincy's far northern reaches came from long drifts leading from No. 8.

In 1911, on the opposite end of the mine, the No. 7 shaft also came to a halt, bottoming out at the 71st level, 6497 feet underground, measured along the incline. At the time, No. 7, not opened till 1900, was the deepest shaft at the mine. But it went no deeper, while Nos. 2, 6 and 8 carried on.

No. 7 stopped because it bottomed out at the property line of the Hancock Mine to the south and west of Quincy.[134] The line of the shaft just struck the northeast corner of Section 27, owned by Hancock. If the shaft could have passed through that corner, it then would have entered the southeastern corner of Section 22, to which Hancock also owned the mineral rights. In 1915 and again in 1919, Quincy made land (or mineral right) purchases from the Hancock Consolidated Mining Company totalling $478,000. These purchases gave Quincy the right to extend the No. 7 shaft; they had bought the mineral rights to land lying in its way. But still the shaft never went beyond the depth obtained by 1911.

As it approached the Hancock Mine boundary, No. 7 was being squeezed out of room. The 1911 Annual Report noted that No. 7 produced "steadily at a rate of about one-half the average of the other shafts,"[136] and the next Report noted "a perceptible decrease" in output:

> At No. 7 shaft the available stoping ground is being steadily mined out. The loss in tonnage from this shaft amounted to a million pounds of copper during the year.[137]

Indicative of the decreasing stoping ground, miners drove 3500 feet of new openings (drifts) tributory to No. 7 in 1911, and only 1800 feet of openings in 1912.

Like No. 9, No. 7 was at least partially done in by the 1913 strike. In effect, Quincy moth-balled No. 7:

> . . . the shafthouse and its equipment have been laid up, steam cut off, and hoisting ropes taken in one the drum to preserve them . . . .[138]

No. 7 remained idle through 1914, and only reopened in August, 1915. But never again did it serve as an important producer for Quincy. In fact, Quincy started sharing No. 7 with the adjacent Hancock Mine. From mid-1915 to mid-1918, Hancock made more use of No. 7 for rock hoisting than did Quincy.[139] (The financial agreements covering this arrangement are unknown.) Only in 1916 did Quincy report even a meagre production from No. 7 -- 15,800 tons of copper rock for the year -- and that was obtained by small crews "scramming" in the old levels, hitting copper rock previously missed. By 1919 No. 7 was closed altogether, never to reopen.

The fates of No. 9 and No. 7, on opposite ends of the mine, demonstrated the impact of the electric locomotives tramming underground. In the era of hand-tramming, neither shaft could have been abandoned without the virtual cessation of mining in their vicinities. But with electric haulage, the shafts were expendable. Quincy did stope out the grounds purchased from the Hancock Mine in 1915 and 1919, the ground that lay in the path of the No. 7 shaft, but it reached it with long drifts, serviced by electric locomotives, coming southward from No. 2 that passed under the No. 7 shaft.[140]

By mid-1913 (the start of the strike) and thereafter, Quincy's fortunes clearly rested on but three shafts: Nos. 2, 6, and 8. Because these shafts would have to bear a bigger burden, Quincy after 1913 paid the most attention to their physical plants. The changes worthiest of note for the entire period of 1905 to 1920 involved shaft-rockhouses, hoists, and energy production and conservation measures.

Quincy significantly modified the construction and operation of its shaft-rockhouses between 1904 and 1912. The goal was two-fold: to reduce the amount of labor required to handle rock, while simultaneously increasing the structures' capacities. An important stimulus for change had been the opening, in 1900, of the second stamp mill on Torch Lake. To maximize the efficiency of the mills, they had to be kept running at full capacity. This strained not only the underground works, but the mine's surface plant as well.

In 1904, the old No. 4 rockhouse served at the test for a a rearrangement of the grizzlies that enabled Quincy "to handle the same amount of rock with 25% less labor."[141] Unfortunately, as was the case in all of the early changes made to Quincy rockhouses, no thorough description of the old and new grizzly set-ups survives. However, the best extant record implies that the grizzlies were reconstructed to provide for the separation of three sizes of rock, rather than just two.[142] The goal seemingly was to sort out the rock that was too big to go directly to the stamp mill, yet small enough for one man to handle at a small crusher. Previously, all oversized rock had followed on track, requiring more men and perhaps more crushers.

The grizzly -- a set of inclined, parallel steel rails or bars -- received the rock trammed from the No. 4 shaft. As the rock slided down the grizzly, if small enough, it fell through. Along the first portion of the new No. 4 grizzly, the bars were set $2^1/_2$" to 3" apart. Rock falling through this section was ready for stamping. It went to a storage bin and then into rail cars for shipment to Torch Lake. The second section of the grizzly carried 10-inch spacings between the bars. Rock falling through here went into a bin that discharged alongside a single crusher. Since no rock was bigger than 10 inches, one man could feed the crusher, while picking out any poor rock or small mass.

After a single crushing, the 10-inch rock was also ready for the mill. The rock bigger than 10 inches slided to the foot of the grizzly, where a larger team of men handled it. This rock, passed through two crushers before it was small enough for the stamp mill. The new grizzlies worked well because the men and machines handling the larger rock were not encumbered by also having to handle the 3" to 10" rock, which now passed through the structure more expeditiously. Quincy modified existing rockhouses -- and designed later new ones -- to operate with the new grizzly design.[143]

While experimenting with the grizzlies, Quincy also tried out the single-step crushing of over-sized rock to stamp-mill size. Other sections have noted that the earlier rockhouses had used large and small crushers. The large crushers provided the intitial break, and then fed directly to the small crushers for a second break. J. L. Harris wrote W. R. Todd in 1905 regarding these trials:

> . . . in regard to crushing rock finer in rockhouses before sending to Stamp Mills, we have been experimenting in this line recently in No. 4 rockhouse by crushing the rock finer in a "secondary" crusher, and are also experimenting in the other rockhouses by crushing rock finer with one treatment; that is, setting the jaws of rock-breaker closer together, which I think will be practical, but -- of course -- requires closer attention in selecting (out) small pieces of barrel work over a certain size, in order to prevent same from clogging and breaking the (machine's) shafts.[144]

The switch to single-step crushing, when adopted, freed the rockhouse structure from the reservation of one floor level solely for the secondary crushers. This would become important, because by 1905 Quincy also realized that the rockhouses needed rearranging to provide for larger bins.

There was never anything particularly sophisticated about the construction of storage bins, whether made of wood or of steel. They simply received rock, dumped right into the top; held it; then discharged it through chutes at the bottom or side, either into machinery for crushing or into railcars for shipment. But the size of the bins came to be important, as this factor affected the overall efficiency of the rockhouses.

The rockhouses (or shaft-rockhouses) were the mine's middle-men. They tood the underground product from the mine, "packaged" it, and shipped it off to the mill. Delays in receiving or disbursing rock could disturb not only the rock-handling function within the rockhouse, but also the hoisting and milling operations. If any rock-receiving bins were too small, they could fill or empty too fast, causing a cessation of hoisting on the one hand, or rock-crushing on the other. The same applied for the final storage bins situated over the rail lines. Small bins demanded more frequent and precisely-timed rail service, to assure that the crushers could keep up their maximum pace.

Quincy modified its shaft-rockhouses built prior to 1905 in order to incorporate the improved grizzlies, single-stage crushers, and larger storage bins. In 1905-1906, Quincy razed the wooden rockhouse portion of the No. 8 shaft-rockhouse, and rebuilt it,[145] using steel-frame construction to make it a taller structure. In 1905 Quincy also introduced the new grizzlies to the No. 7 shaft-rockhouse, and in 1907 it raised that structure too, by some ten feet. The company installed new 36" x 24" rock breakers and increased the storage bin apacity from 150 to 750 tons. As a result, Quincy claimed that the cost of rock handling at No. 7 was reduced by half. In 1908 Quincy raised the height of the No. 8 shaft-rockhouse another 8 feet, to increase further the capacity of the upper level bin for storing copper rock before it was crushed.[147] In 1912, the company revamped the No. 6 structure -- the original combination shaft and rockhouse at the mine. Again it raised the structure, installed new 36" by 24" crushers at a higher level, and increased rock bin capacity from 200 to 800 tons.[148]

Quincy claimed that significant cost reductions attended all of these modifications, with most of the savings coming from reduced labor costs. In 1904, for example, 28 men worked in the No. 7 shaft-rockhouse and processed less than 900 tons of rock per day. The 1905 remodeling reduced the labor force to 16, and the 1907 changes dropped it to only 5. While the number of workers declined, the capacity of the structure rose; the five men in 1907 could handle 1,800 tons of rock daily.[149]

While partial reconstructions or additions sufficed at the No. 6, 7, and 8 shaft-rockhouses, No. 2 required a totally new structure. The wooden, many-gabled shaft-rockhouse built in 1894-1895 had deteriorated by 1907, in part due to the vibration and stresses caused by the machinery, but in large measure due to humid upcast air coming from the mine. The continuous moisture had severely weakened the timbers,[150] so in mid-1908 Quincy began dismantling the No. 2 shaft-rockhouse while simultaneously erecting its successor. The new steel-frame No. 2 shaft-rockhouse represented the culmination of Quincy's drive to reduce rock-handling costs, and because of its efficiency it garnered considerable attention from mining engineers. Representing the last stage in the long evolution of Quincy rockhouse design and practice, the structure merits discussion. (See numerous HAER photos of this structure, plus HAER drawings.)

The 1908 No. 2 shaft-rockhouse erected by the American Bridge Company stood almost 150 feet tall. The double skip road leading up nearly to the sheaves had dumps at three levels. Just above the shaft collar the first dump discharged extremely large mass copper and tools, such as bundles of dull drill steels. Sliding down a ramp to a platform just above ground level, these materials were readily loaded onto railcars passing beneath (or through) the structure. The second dump discharged poor rock into a storage bin. The bin in turn chuted materials either to rail cars or to a 24" by 18" crusher, which broke the poor rock into a size suitable for concrete or road work (ballast). The highest dump discharged the contents of the 8-ton skips (after 1920, 10-ton skips) onto inclined grizzlies, one above the other, elevated over the main crusher or copper-rock floor.

The top grizzly, 16 feet long, composed of 6-inch round steel bars and inclined at 16 degrees from the horizontal, carried 20-inch wide openings. All rock larger than 20-inches carried all the way to the end of the grizzly, then dropped into a bin whose one side opened to a 3,000-pound drop hammer. The rock smaller than 20 inches fell onto a second grizzly made of $3^1/_2$" round steel bars, 6 feet long, inclined at 30 degrees, and having $2^3/_4$" openings. The undersized rock fell through the second grizzly into a main stamp rock storage bin with a 2,000-ton capacity; it was ready for the mill. The oversized rock fell into a separate, higher "copper rock" bin, which would feed it to crushers.

The 3,000-pound drop hammer, a steam hammer, and two 36" by 24" crushers were tightly clustered on the copper-rock floor. The largest rock and mass (over 20 inches) sent to the drop hammer, carried by a travelling air-powered lift. Once hammered, the large mass copper was lowered outside the building to railcars by a crane; smaller mass was dropped into a chute leading to a mass copper storage "tube," running up one outside corner of the shaft-rockhouse. Any discovered poor rock was chuted to the poor rock bin via a slide; and copper rock went to the crushers or to the steam hammer.

The copper rock bin (storing the rock some 3 to 20 inches in size) chuted directly to the two crushers, each tended by one man. Besides feeding the crushers, the men picked out the poor rock and mass copper. Chutes carried poor rock to its bin; the mass went to the nearby steam hammer for cleaning before being chuted to the mass copper tube.The steam hammer operator also tended the drop hammer and kept all the machinery oiled and in repair. The three men on the copper rock floor could treat upwards of 1,000 tons of rock in 12 hours. All the material ended up in bins elevated over rail lines that ran under or alongside the No. 2 shaft-rockhouse. The bin chutes were air-operated, and a rail car could be filled in some 10 seconds, once it was in place.[151]

The structure contained other equipment of some interest; a Corliss engine and a standby electric motor to power the crushers and the winch for raising the drop hammer; cranes for holding and moving the man-car, bailing skips, and rock-skips (which could be changed one for another in a matter of minutes); and levers at the ground floor that the lander could pull to move the right section of skip-road track, causing the skip to sump at the desired level. All in all, this structure was better integrated in its design that the earlier shaft-rockhouses, for there were no distinguishable "shafthouse" and "rockhouse" wings. The rock-handling process was more linear. The structure minimized the distances traveled by the materials and the number of times they had to be handled.

The improvements just noted were virtually the last to be made by Quincy at its shaft-rockhouses; the company had devised a system it would now use till the end. Between 1905 and 1920 Quincy also made substantial improvements to its hoists, and just as the company would end with a monumental shaft-rockhouse at No. 2, so too would it end up with a monumental hoist there.

Between 1905 and 1920, Quincy's principal shafts increased in depth by roughly 50 percent, moving from 5000 down to over 7000 feet. Shaft-sinking proceeded at a rate that strained the depth capacities of several hoists. Whenever Quincy literally reached the end of its rope, it had several possible actions to take. It could by an new hoist engine and drum, which by now, at these depths, had become an extremely expensive proposition. It could rebuild or modify an existing engine and/or its drum, or it could cease hoisting from a given shaft altogether.

The choice depended on a number of factors. One very important criteria, of course, was the life-expectancy of a shaft. Quincy was understandably unwilling to expend upwards of $100,000 to upgrade or replace a hoist at a shaft which was deemed nonessential (due to underground electric haulage), or which was passing into poorer ground. Contributory to the closings of shafts 4 and 7 may well have been the fact that the hoists there had reached (or nearly reached) their depth limits. The No. 4 hoist limped into this period, having reached its maximum depth at the 51st level (a little over 4000 feet) by 1899.[152] At No. 7 -- sunk faster than any other shaft in the mine's history -- the shaft went to its terminal depth of 6497 feet between 1900 and 1912. That was still shy of the reported 8000-foot capacity of the original E. P. Allis engine at No. 7, but projecting a shaft-sinking rate of 150 to 200 feet per year, the No. 7 engine would have about reached its limits by 1920. In the short run, Quincy must have deemed it less expensive in terms of operating costs to run only the No. 2 engine, to shut down No. 7, and to use electric haulage, tramming to No. 2, to remove copper rock from beneath No. 7. In the long run, the closing of No. 7 meant that by 1920, only one new hoisting engine would be needed at No. 2 -- and not new engines at both Nos. 2 and 7.

In 1905 Quincy had a thirteen-year-old E. P. Allis & Co. hoisting engine at No. 6, but the cylindrical drum was only three-years-old and had a depth capacity of 7,200 feet. With that drum in place, the No. 6 hoist plant operated to 1920 without any significant modifications. Quincy did not escape major equipment changes at Nos. 8 and 2, however.

When installed in 1905, the Nordberg hoist with a conical drum at No. 8 had an expected working life of twenty years. It did not make it, for two reasons. First, Quincy pushed shaft-sinking at No. 8 faster than had been expected and thus outstripped the equipment's depth capacity of 5000-5500 feet. Secondly, Quincy grew more conscious of fuel consumption and efficiency and sought to upgrade the No. 8 plant in the face of these concerns. After running the Nordberg hoist for only seven years, Quincy entered a new contract with Nordberg to modify the engine extensively.

Unfortunately, many of the specifics regarding the Nordberg contract work (completed in 1913) are unknown. Quincy added a larger drum; compounded and condensed the engine for greater steam efficiency; and ended up with an engine that failed to work very well.

The original Nordberg installation at No. 8 was neither a compound nor a condensing engine. It was a duplex with Corliss valve gear. A 32" x 72" engine stood on each side of the drum and operated on 100 pounds of steam. Each engine had its own steam supply, which was used once and then exhausted. To "compound" the hoist meant redesigning it so that the steam was used twice. After high pressure drove the piston in one cylinder, it exhausted not into the atmosphere, but into a second, larger cylinder. This cylinder needed to be larger because the steam, having expanded once in the first cylinder, had lost pressure. To generate as much power in the second cylinder as it had in the first, the steam had to act against a larger piston. To further boost the effectiveness of the steam in the second engine, Quincy had Nordberg make it condensing. In non-condensing engines (such as all those Quincy had ever used up till now), the steam on the power side of a double-acting piston was opposed by atmospheric pressure (about 15 pounds per square inch) on the exhaust side. In condensing the low-pressure engine of the revamped No. 8 hoist, cold water contacted the exhaust steam -- thus turning a large volume of steam into a small quantity of water. This created a near vacuum on the exhaust side of the piston; steam on the power side no longer worked against 15 pounds of atmospheric pressure.

While effecting all these changes, Quincy added a new conical drum of unknown size; new high pressure boilers, which probably increased the steam pressure to about 150 pounds; plus a condensor and new steam receivers.[153] At the least, Nordberg had to supply an entirely new cylinder and piston -- larger than the original 32" bore -- to serve as the hoist's low-pressure side. This would have retained one side of the original hoist to operate as the high-pressure side, thus reducing the cost of the modification. But Nordberg may have produced two entirely new cylinders, plus other parts of the driving gear. Regardless, the changes released "part of the No. 8 hoisting machinery (the drum and at least one-half of the original duplex engine) for use at No. 9 shaft."[154]

The changes, whatever their exact form, proved disappointing. The purpose had been to cut the amount of fuel needed to drive a bigger drum,[155] but Quincy did not see a big reduction in coal consumption at No. 8. Quincy may have expected a reduction of up to 40 percent,[156] but tests in January and February, 1915, done long after any bugs should have been worked out, indicated that the compound-condensing engine was "saving about twenty per cent in coal over the requirements of the old hoist, as shown by the records for the years 1909 and 1912."[157] The mining company blamed the hoist specialists for the machinery's apparent failure to conserve more fuel.

The Quincy-Nordberg finger-pointing dispute over the poor performance of the altered No. 8 hoist cannot be documented in detail, but the known facts are interesting. Quincy -- which since the 1890s had relied heavily on outside expertise in deciding sophisticated technological problems -- had apparently gotten in over its head on this one. In essence, the mining company rather lamely ended up blaming Nordberg for not having rejected Quincy's own plans for the hoist modification. Nordberg said that it had only followed Quincy's directions; Quincy rebutted that Nordberg should have known better:

> Mr. O'Neill (a Nordberg engineer?) also criticized our not having an engineer in our employ who could correctly advise us on such matters. Of course we told him that we considered Mr. Nordberg an expert of high ability and authority on deep hoisting, and that we fully relied on his knowledge and ability to furnish us with a proper and perfect Hoisting Engine, and that we never believed that they would go ahead and build an engine for us that would not hoist about as economically as a new one.[158]

The new conical drum at No. 8 must have had a depth capacity of about 6000 feet; in 1918, when the shaft reached that depth, Quincy had to install a rope guide for the No. 8 drum.[159] Normally, in winding during a lift, the rope built up on one end of the drum only, starting at the small diameter of the cone and moving up towards the large diameter at the drum's center. By 1918, the hoisting rope exceeded the length that could be wound on half the drum, so the guide served to send rope over the top of the drum and down the cone on the other side. This impaired the mechanical advantages provided by the conical shape, but it was an expedient way of going deeper without the expense of a new drum. And Quincy envisioned this as merely a temporary measure. In 1917, when both No. 8 and No. 2 (at 7289 feet) had extended their hoists about to the limit, Quincy had ordered an entirely new hoist for No. 2.[160] When that machinery arrived, the company's plan was to shift the old No. 2 hoist over to No. 8, where it would suffice for the next 1,300 or so feet of shaft-sinking.

Despite its problems with Nordberg's 1912-1913 work on the No. 8 hoist, in 1917 Quincy turned to the same company for a new engine at No. 2. This time Quincy was taking no half-hearted measures; it did not attempt, as it had so many times before, to wangle a few year's more service and a few hundred more feet of rope out of older equipment. It ordered the largest hoist in the world.

Nordberg prepared specifications and a proposal covering the engine in November 1916,[161] and Quincy contracted for it early in 1917. Delivery time was to be 14 months, but World War I, and restrictions on the production of heavy machinery, delayed Quincy's receipt of the engine until late in 1919. (Quincy and Nordberg petitioned the government, but without success, to have the hoist reclassified as an object important to the war effort, and therefore in immediate need.) Some idea of the size and complexity of the hoist can be gained by the fact that it took nearly a year to install and prepare for operation. The hoist house was contracted for and essentially completed in 1918; its plans included large doorways, an overhead crane, and other facilities to ease the hoist's installation. Erecting crews started on the hoist in December 1919, yet it did not hoist its first rock until November 10, 1920.[162]

Numerous HAER graphics (modern and historic photographs, plus measured drawings) portray the Nordberg No. 2 hoist far better than any words. No thorough technological description will even be attempted here; only the machine's most notable features are covered.[163] But it is important to note at the beginning that Quincy in large measure was basing its economic survival on machines like the Nordberg hoist. Miners at No. 2 were already working nearly a mile and a half underground. If the technology did not improve, going deeper could only drive production costs up. It was Quincy's expectation "that the hoist when completed will reduce the cost for hoisting with increasing depth, below the present cost for hoisting at lesser depth."[164] To realize this hope, the new hoist had to pull larger loads faster, and consume less fuel in the process.

The hoist alone cost $180,000; total cost for erecting the hoist, the hoist house, and all auxiliary facilities ran $370,000. The grooved, cylindro-conical drum, 30 feet in diameter in the center, could carry 10,000 feet of $1^{5}/_{8}$" wire rope in one layer on the cylindrical section and one conical end. The cross-compound hoist engine was actually four engines in one: two high pressure cylinders on one side of the drum (mounted on an inverted V-frame, 32" by 66" bore and stroke, running on 160 p.s.i.) and two low-pressure cylinders on the other (60" by 66", running with a condenser). The double-acting pistons provided eight impulses or power strokes per revolution of the drum. The drum, turning 34 revolutions per minute, could hoist skips enlarged to 10-ton capacity at a rate of 3,200 feet per minute -- or 36 miles per hour.

The new hoist worked well, save for an accident in 1922 when a piston follower came loose on one of the low-pressure cylinders and smashed up the head.[165] It was the fastest hoist at the mine, raised a 10- instead of an 8-ton skip, and most importantly, it conserved large quantities of coal. In each of the years 1920 and 1921, the No. 2 hoists (old and then new) brought up 52,000 skips and a quarter-million tons of copper rock and mass. The Nordberg hoist in 1921 consumed 6,500 tons of coal -- 2400 fewer tons than the old Allis hoist in 1920. With coal at $6.729 per ton, this represented a savings in fuel costs of $16,080. Subtracting out the additional labor costs involved in running the new hoist (three extra wipers), the Nordberg engine brought a net savings in its first year of $14,000.[166]

The coal for No. 2 was burned in a "No. 5" boiler house, located right behind the hoist house, that had been built in 1912.

Besides renewing its boiler facilities and turning to compound-condensing engines, Quincy took other energy conserving measures during this period, such as going to boiler feed-water heaters, and putting into steam-regenerator and General Electric low-pressure turbine to use steam exhausted from its hoists to drive electric generators.

Despite all of its troubles, Quincy paid handsome dividends from 1905 to 1920. It never missed a beat -- not even during the strike years in 1917, when the annual dividend was nearly $2 million.[167] But a drastic falling off was just around the corner.

The new Nordberg hoists was conceived of during the boom years of World War I. Housed in its impressive structure, clad in brick veneer and topped off with a green tile roof, it was a symbol of economic well-being, and of a hopeful future. But the hoist was delayed in its receipt, and its late start up coincided with Quincy's last dividend payment -- with the cessation of the string of profitable years that stretched back to 1868.

If Quincy maintained an optimistic face in public, in private the mine's future was clouded. In July 1919, Charles Lawton received a report from one of his staff, H. L. Chamberlin.[168] It appears that the report was confidential, for there is no evidence that Lawton passed it on to anyone else. Chamberlin titled his work "An Estimate of the Probable Working Life of the Quincy Mine." He gave Quincy's works on the Pewabic Lode -- then 63 years old -- just another ten years.

NOTES -- CHAPTER IV

[1] QMC 1906 Annual Report, p. 11.

[2] Ibid., pp. 12-13.

[3] QMC 1914 Annual Report, p. 13.

[4] QMC 1906 Annual Report, p. 11.

[5] Ibid., p. 12.

[6] Thiel Detective Service to QMC, Sept. 27, 1906.

[7] C. L. Lawton to W. R. Todd, Aug. 12, 1921.

[8] Otto Kirchner to W. A. O. Paul, Dec. 11, 1909.

[9] Lawton to W. Parsons Todd, July 29, 1918.

[10] QMC report, "Cost of Producing Copper. . . Should be Less Regardless of . . . Increasing Depth," c. 1921.

[11] Ibid.

[12] QMC 1906 Annual Report, p. 13.

[13] QMC 1907 Annual Report, p. 14.

[14] QMC 1909 Annual Report, pp. 12-13.

[15] QMC 1914 Annual Report, p. 6.

[16] QMC 1915 Annual Report, p. 14.

[17] QMC 1916 Annual Report, p. 12.

[18] QMC table, "Air Blast Data From March, 1918, to April, 1920."

[19] Lawton, "Air Blast Repairs and Expenses," table sent to W. R. Todd in letter, May 11, 1921.

[20] QMC 1907 Annual Report, p. 14.

[21] C. L. Lawton, draft letter, n.d., no addressee.

[22] "Cost of Producing Copper. . . Should be Less. . . ."

23 Lawton to W. R. Todd, Nov. 3, 1919.

24 QMC 1914 Annual Report, p. 14.

25 QMC 1915 Annual Report, p. 14.

26 "Cost of Producing Copper. . .Should Be Less...."

27 QMC 1914 Annual Report, p. 14.

28 U. S. Patent 1,151,955, Aug. 31, 1915.

29 Lawton to W. R. Todd, Dec. 1, 1914.

30

31 Lawton to W. R. Todd, July 16, 1918.

32 W. Parsons Todd to Lawton, July 25, 1918.

33 Lawton to W. Parsons Todd, July 29, 1918.

34 W. Rogers Todd to Lawton, Aug. 2, 1918.

35 Lawton to W. Parsons Todd, July 29, 1918.

36 QMC 1923 Annual Report, p. 13.

37 "Cost of Producing Copper. . . Should Be Less. . . ."

38 QMC report, "Surface and Underground Materials," c. 1927, p.11.

39 Lawton to W. R. Todd, Oct. 28, 1919.

40 QMC, H. L. Chamberlin report, "An Estimate of the Probable Working Life of the Quincy Mine," July 3, 1919.

41 "Surface and Underground Materials."

42 The exact timing of these changes is unknown.

43 " An Estimate of the Probable Working Life of the Quincy Mine."

44 Lawton to W. Parsons Todd, Feb. 3, 1921.

45 "Surface and Underground Materials," p. 12.

46 *Ibid.*, p. 13.

47 QMC 1907 Annual Report, p. 12-13.

[48] Copper Handbook, v. X, p. 1444.

[49] QMC Annual Report, 1908, p. 10-11.

[50] See QMC 1911 Annual Report, p. 12. Reference is made to the fact that Quincy had been trying out "lighter weight machines" for several years, and had one-hundred in operation.

[51] Chief Engineer to Lawton, Nov. 7, 1913.

[52] Ibid.

[53] "Cost of Producing Copper. . . Should Be Less...." Also see 1911 Annual Report, pp. 12-13.

[54] QMC 1911 Annual Report, p. 13. Also 1912 Report, p. 17.

[55] QMC, "Drilling Machine Record," June, 1913, and "Machine Drill Inventory," Sept. 30, 1914. Also, "Drilling Machine Data," n.d., and Chief Engineer to Lawton, Nov. 7, 1913. These documents suggest that Quincy purchased and extensively tried at least five different machines, and studied perhaps seven to nine others.

[56] "Drilling Machine Data," n.d. and Chief Engineer to Lawton, Nov. 7, 1913.

[57] "Cost of Producing Copper. . . Should Be Less...."

[58] QMC 1913 Annual Report, pp. 14-15.

[59] The identification of the jackhammers' manufacturers comes from "Machine Drill Inventory," Sept. 30, 1914.

[60] "Machine Drill Inventory," July 10 and 18, 1918.

[61] Daniel C. Smith to W. R. Todd, May 30, 1914. This is a second letter of the same date, and differs from the one cited in the text.

[62] Chief Engineer to Lawton, Nov. 7, 1913.

[63] Daniel C. Smith to W. R. Todd, May 30, 1914.

[64] Ibid.

[65] Ibid.

[66] QMC report, "Conclusions of Analysis of Drilling Operations," Dec. 8, 1914.

[67] Ibid.

68 "Exhibit A" in "Cost of Producing Copper. . . Should Be Less...."

69 QMC report, "Narrower Stope Mining," n.d.

70 "Exhibit A" in "Cost of Producing Copper. . . Should Be Less...."

71 Ibid.

72 Smith to W. R. Todd, May 30, 1914.

73 "Exhibit A" in "Cost of Producing Copper. . . Should Be Less...."

74 Lawton to W. R. Todd, May 18, 1912.

75 W. R. Todd to Lawton, May 10, 1912.

76 Lawton to W. R. Todd, May 13, 1912.

77 W. R. Todd to Lawton, May 15, 1912.

78 Lawton to Todd, May 18, 1912.

79 "Machine Drill Inventories," Sept. 30, 1914 and July 10 and 18, 1918.

80 Engineering and Mining Journal, July 10, 1915, p. 53.

81 Crane, U. S. Bureau of Mines Publication Bulletin 306, "Mining Methods and Practices in the Michigan Copper Mines," pp. 130-131.

82 T. A. Richard, Copper Mines of Lake Superior (1905), p. 67.

83 QMC card file, "Data on Quincy Shafts," Dec. 31, 1909.

84 QMC 1918 Annual Report, p. 15.

85 "Cost of Producing Copper . . . Should Be Less...."

86 QMC 1918 Annual Report, pp. 15-16.

87 QMC 1925 Annual Report, p. 13.

88 "Exhibit L" in "Cost of Producing Copper. . . Should Be Less...."

89 Ibid.

90 QMC 1925 Annual Report, pp. 13-14.

91 QMC 1930 Annual Report, p. 13.

92 "Exhibit K" in "Cost of Producing Copper. . . Should Be Less...."

93 J. L. Harris to W. R. Todd, April 4, 1903.

94 QMC 1909 Annual Report, p. 17. Shown in QMC drawing 906F, March 15, 1911.

95 QMC 1912 Annual Report, p. 14.

96 QMC 1917 Annual Report, p. 17.

97 "Exhibit G," in "Cost of Producing Copper . . . Should Be Less...."

98 "Exhibit H," in "Cost of Producing Copper . . . Should Be Less...."

99 T. C. DeSollar, "Handling Underground Waste Rock Through Underground Skip Dumps, QMC," in Proceedings of the Lake Superior Mining Institute, v. XXII (1922), p. 42.

100 Ibid., p. 44.

101 Extant hoisting charts dated Oct. 1914 were found in the company records.

102 Lawton to Todd, Dec. 22, 1920.

103 "Exhibit J" in "Cost of Producing Copper. . . Should Be Less...."

104 QMC 1916 Annual Report, p. 14.

105 "Exhibit I" in "Cost of Producing Copper. . . Should Be Less...."

106 Ibid.

107 "Exhibits I and J," in "Cost of Producing Copper. . . Should Be Less...."

108 QMC 1926 Annual Report, pp. 6, 12.

109 "Exhibit R" in "Cost of Producing Copper. . . Should Be Less...."

110 J. L. Harris to W. R. Todd, Sept. 6, 1902.

111 J. L. Harris to W. R. Todd, Sept. 22, 1902.

112 J. L. Harris to W. R. Todd, Jan. 6, 1903.

113 J. L. Harris to R. T. McKeever, March 15, 1904.

114 Thiel Detective Service to QMC, Sept. 11, 15 and 21, 1906.

115 QMC card file, "Temperatures, No. 2 Shaft," June 21 and 22, 1921.

116 QMC 1914 Annual Report, p. 19; QMC Supplies Purchased, 1911-1913 and 1913-1916, numerous entries.

117 See Terry Reynolds and Ron Wilson, HAER report on Michigan Lake Superior Power Company.

118 QMC 1914 Annual Report, p. 19.

119 J. L. Harris to Horace J. Stevens, Nov. 14, 1902.

120 J. L. Harris to W. R. Todd, Aug. 12, 1902.

121 Ibid.

122 Ibid.

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127 QMC 1908 Annual Report, p. 9.

128 QMC 1909 Annual Report, p. 14.

129 QMC 1912 Annual Report, p. 17. Also Lawton to W. Parsons Todd, Aug. 11, 1920.

130 QMC 1913 Annual Report, p. 19.

131 QMC 1914 Annual Report, p. 17.

132 QMC 1913 Annual Report, p. 22.

133 Lawton to W. Parsons Todd, Aug. 11, 1920.

134 QMC Map, "Quincy Property," Nov. 1910, with 1912 and 1914 revisions.

135 QMC 1915 Annual Report, pp. 6, 11-12; 1919 Report, p. 7.

136 QMC 1911 Annual Report, p. 11.

137 QMC 1912 Annual Report, p. 12.

138 QMC 1913 Annual Report, p. 13.

139 QMC Annual Reports: 1915, p. 12; 1916, p. 11; 1917, p. 13; 1918, p. 13.

140 For example, the 72nd level from No. 2 extended 1500 feet south to the territory of No. 7. This work was done in 1916. See QMC 1916 Annual Report, p. 12.

141 J. L. Harris to W. R. Todd, Dec. 22, 1904.

142 Ibid.

143 J. L. Harris to Gilliland, March 13, 1905.

144 J. L. Harris to W. R. Todd, Sept. 26, 1905.

145 J. L. Harris to W. R. Todd and to E. E. Green, Aug. 5, 1905.

146 J. L. Harris to W. R. Todd, Aug. 5, 1905; QMC Annual Report, 1907, p. 11.

147 QMC 1908 Annual Report, p. 10.

148 QMC 1912 Annual Report, pp. 14-15.

149 Copper Handbook, v. X, 1910-1911, p. 1445.

150 QMC 1907 Annual Report, p. 13.

151 This technological description of the No. 2 shaft-rockhouse was based on an examination of the structure (still standing in 1978) and upon two articles: L. Hall Goodwin, "Shaft-Rockhouse Practice in the Copper Country --IV," Engineering and Mining Journal, July 10, 1915, pp. 53-56; and T. C. DeSollar, "Rockhouse Practice of the Quincy Mining Company," Proceedings of the Lake Superior Mining Institute, v. XIII (1912), pp. 217-226.

152 QMC 1899 Annual Report, p. 10. Quincy must have lagged the No. 4 drum, or made some modification, because by the end of 1902 No. 4 was down to the 53rd level and 4300 feet.

153 QMC 1913 Annual Report, p. 2.

154 QMC 1912 Annual Report, p. 17.

155 W. R. Todd to Lawton, Nov. 4, 1914.

156 See Power, Jan. 18, 1921, p. 92. This article says that a properly designed compound condensing hoist will consume only 50 to 60 per cent of the steam used by duplex Corliss hoists, and only 20 to 30 per cent of the steam used by a slide-valve hoist.

157 G. L. Thorstensen to Lawton, March 6, 1915.

158 W. R. Todd to Lawton, Nov. 4, 1914.

159 QMC 1918 Annual Report, p. 16.

160 QMC 1917 Annual Report, p. 17.

161 Nordberg Manufacturing Company, "Prop. No. 4558," Nov. 11, 1916. (Found in QMC Records.)

162 QMC Annual Reports: 1919, p. 16; 1920, p. 15.

163 For more complete descriptions of the hoist, see Thomas Wilson, "Quincy Hoist -- Largest in World," Power, Jan. 18, 1921, pp. 90-95; "The World's Largest Compound Steam Hoisting Engine," Proceedings of LSMI, XXVII (1929), pp. 18-20; Ray W. Armstrong, "Compound Steam Hoist Installation of the Quincy Mining Company," Proceedings of LSMI, XXII (1922), pp. 39-41; "Nordberg Compound Steam Hoisting Engine, Quincy Mining Company, No. 2 Shaft, Hancock Michigan," Proceedings of LSMI, XXII (1922), pp. 192-194; "The Quincy Hoist," Engineering and Mining Journal, Dec. 11, 1920, pp. 11, 126.

164 QMC 1917 Annual Report, p. 17.

165 Lawton to W. R. Todd, March 8, 1922.

166 QMC, "Comparison of No. 2 Hoists, New and Old," and QMC 1921 Annual Report, p. 13.

167 QMC 1920 Annual Report, n.p., "Record of Dividends Paid by Quincy Mining Company from Organization to Dec. 31, 1920.

168 Chamberlin's report found in QMC records.

CHAPTER V

For Quincy and other Michigan copper producers, the Great Depression arrived nearly a full decade early. The bouyant copper prices of World War I disappeared, and the copper market crashed. In 1921, Quincy's average sale price for a pound of copper was less than half of what it had been in 1917; the price had dropped from 28.6 cents per pound to only 13.5 cents. At the same time, Quincy's costs of producing a pound of copper dropped from 17.5 to 15.2 cents per pound.[1] As a net result, the mine was in a totally unfamiliar situation: it was now losing money on every pound of copper it extracted, milled, and then smelted.

In the front of its 1920 Annual Report, Quincy proudly listed its long history of 127 dividend payments that had totalled just over $27 million. From 1921 through 1931, the company added no new dividends to that list, as it reported annual losses, rather than profits. The price of copper was not alone in plaguing the company. All the problems incurred in the 1905 to 1920 period still remained -- the structural instability of the underground works, labor shortages, a narrowing lode, greater depths, more heat, poorer ventilation, and more water. It was these problems, combined with market prices, that threatened the mine's very survival.

In retrospect, if there is a surprise to be found in examining Quincy from 1920 to 1931, it is that the company lasted as long as it did before closing down. In the face of great losses it struggled on. As long as the market was so depressed, Quincy found itself in a no-win situation, and it saw annual deficits as the lesser of two evils. The greater evil was the cessation of mining altogether. The company feared that once Quincy closed, it would never reopen. As long as some kind of production was maintained, there was always the hope that the mine -- with a more favorable market -- could still turn its fortunes around.

Quincy's copper production from 1920 to 1930 is shown in Table 5.1. These figures clearly show a company in decline. From 1905 to 1920, Quincy often had to struggle to maintain its highest production plateau ever, of 16 to 22 million pounds annually. Now the attempt was more modestly to keep going at whatever level; to try to trim production costs to bring them as close as possible to copper prices; and to hope for an upturn in the market.

Table 5.1

Quincy Ingot Production

Year	Production (millions of pounds)
1920	19.2
1921	16.9
1922	15.4
1923	13.0
1924	14.8
1925	14.4
1926	13.2
1927	9.7
1928	1.2
1929	4.5
1930	10.9

SOURCE: QMC Annual Reports

The structural instability of the mine greatly exacerbated Quincy's economic woes. The air blasts did not stop, and increased rock pressures and safety concerns eventually forced the company to make the expensive switch over to mining on the retreating system. The air blasts once again proved the fragility of Quincy's shafts, and the foolhardiness of not protecting them from the surface down with broad pillars.

On July 12, 1922 a series of air blasts crushed the No. 6 shaft between the 46th and 66th levels -- the same stretch of shaft crushed in 1916. The fall stopped all hoisting at No. 6 for three and a half months.[2] On Feb. 16, 1923, the footwall of the No. 6 shaft, at the 39th level, "fell into an old stope beneath, that was made in 1896."[3] Quincy was three weeks getting the shaft refitted for hoisting. On Nov. 27, 1924, air blasts again crushed the No. 6 shaft, this time between the 59th and 67th levels. Hoisting stopped for nearly six weeks, and the one incident cost Quincy $40,000 in repairs and in the loss of production.[4]

Such collapses were extremely critical, because Quincy had so few shafts in operation. The No. 4 shaft had been shut down in 1909, and Nos. 7 and 9 ceased in 1913. So Quincy entered the 1920s with only three open shafts: 2, 6, and 8. And as an economy measure, to reduce operating costs, Quincy mothballed No. 8 in 1922. In that year, No. 8 was at the 75th level, or 6634 feet deep, and it stayed there for six years. Meanwhile Nos. 2 and 6, at 8009 and 7456 feet respectively, went deeper. Quincy reopened No. 8 in 1928, one year after yet another catastrophe struck one of its shafts -- this time No. 2.

In a sense, Charles Lawton foreshadowed the No. 2 disaster in a letter to William Parsons Todd written three months before the start of an extensive and tragic ordeal involving both fire and air blasts:

> Commencing last evening at sharp ten o'clock, when three heavy air blasts commenced a series that jarred this community, there have been fifteen old rousers during the night, as heavy as any we have ever experienced, with a lot of little ones thrown in. What they are, where they were, we do not know.
>
> One very heavy one has teken place while the captains were underground. Captain Francis, in the top levels of No. 6, reports it to be over North. Captain Maunders, in the top levels of No. 2, reports it to be South, so there you are. But, this earth's surface did jar tremendously, and put the fear of the next world into the hearts of everyone.[5]

Such fear was far from unjustified, as events would soon demonstrate. But the disaster at No. 2 started with a fire, not an air blast.

The first indication of trouble came at about 3 o'clock in the morning of July 13, 1927. The electric light and bell hoist signaling system in No. 2 stopped working. In seeking the cause of an open circuit, men discovered fire in the shaft near the 53rd level. They did not know and would never discover the cause of the blaze: perhaps an electrical short, perhaps the friction of the hoist rope on a faulty sheave. Word of the fire quickly spread, and all underground workers escaped to No. 6, where they were hoisted out, suffering no casualties.

Quincy had little experience with fires. Ironically, one cause of the structural instability of the mine -- a history of little or no timbering for supports -- helped protect the mine from the other danger of fire. There simply was not all that much wood to burn underground. But fires -- like air blasts -- threatened the crucial shafts more than any other part of the mine.

On the surface, Charles Lawton ordered one attempt at going down into the mine to check the extent of the fire. The fire crew from the neighboring giant, Calumet & Hecla, went down with breathing apparatus, but they were unable to reach the blaze. By noon on the 13th, Lawton had taken the only measure he could to check the fire's spread and to snuff it out: he ordered the shafts sealed. He "did not see any other way out."[6] They would close the underground works off from the atmosphere, thus smothering the fire.

Quincy was not fully prepared to fight a big fire, but it had shown some foresight. The concreat collars at each of the shafts held steel fire doors. These doors were closed and sealed with wet clay. This was not an aggressive way to fight a blaze. You sealed the mine as best you could; checked for all possible air leaks; and waited for it to die out. Meanwhile, the entire mining operation ceased. And you could not allow anxiety to force you back to the mine too soon, for the reentry of fresh air could ignite the fire again, unless it had completely died out.

Quincy was not particularly well disposed towards the U. S. Bureau of Mines, but Lawton wanted help. Just as he had immediately turned to the Calumet & Hecla fire crew, so did he turn to the Bureau. Lawton and Dr. W. O. Hotchkiss, the President of the Michigan College of Mines, wired of the emergency to the Bureau's

Duluth office and requested aid. At 10 a.m. on July 14, the Bureau's railroad car No. 8 rolled up to the mine with its crew of technical experts.

The Bureau team concurred with Lawton's judgment: "The sealing of the entire mine, when the fire was found to be out of control, was the only practical way to fight it."[7] One of the emergency team's chief contributions was in training twenty Quincy miners in the use of oxygen breathing apparatus. These men would be the first to go back underground, to assure that the fire was dead, and they would go back in before the mine was rid of killing smoke and fumes. Lawton wrote to W. Parsons Todd:

> They are men long in the employ of the Quincy and are our old standbys. New men would not take the risk of going underground with the deadly gases, with gas masks on or breathing apparatus; they don't have to; the others do -- on account of their loyalty.[8]

The other principal activity of the Bureau team was sampling the air from the mine at the shaft collars. They monitored the fire's progress by measuing the oxygen content in the mine. When the oxygen level stopped dropping and held steady, the fire was out -- or nearly so.

In an ironic sense, Quincy's poor economic condition at the time might have made the wait more bearable. W. Parsons Todd urged Lawton to be patient in a letter tinged with a macabre sense of humor:

> I assume that we are not losing any more money with the mine closed than we were when operating on a $12^1/_2$ cent

> copper market, and it is possible that you may be able to reduce the force so that we will actually lose less; therefore, we have considerable to lose and very little to gain by opening the shafts to soon.[9]

Quincy's "helmet men" with their breathing apparatus went into the mine eight or nine days after the fire started, riding a specially-rigged man car ever-so-carefully down into the No. 2 shaft.[10] Conditions looked good; the fire was practically smothered. They tried reopening the shaft on August 3, but the fire flared up, to they resealed the mine. Finally, by August 10 the fire was out, and by the 13th, the mine was free of smoke and gase. On August 15, Quincy started repair work on No. 2 and production at No. 6.

The fire had been confined to the No. 2 shaft, but 2,500 feet of it had to be rebuilt, from the 53rd level up to the 18th. In its Annual Report for 1927, Quincy said it had been "exceptionally fortunate in being able to confine so hot a fire to such a restricted area, and to have smothered it out so quickly."[11] But greater misfortune followed the fire.

It would take months to restore the burned out portion of No. 2. By October 29 the work had progressed as far down as the 41st level, where Captain Maunders had a highly experienced crew of timbermen rebuilding the shaft.[12] Like the 20 men trained for the fire rescue team, these timbermen must have been Quincy's "old standbys," willing to undertake the high-risk worked needed to reopen the shaft, and skilled enough to do it with dispatch. The team boss, George Williams, was 63 years old. The youngest man, a Pole named Joseph Konosky, was 34. Arvid Naasko, born in Finland, had worked for Quincy for 20 years, as had Henry Hirsikowski. Emil Aitama had 22 years at Quincy, and Earnest Schilling, 23 years. John Israelson, 47, had been born at Quincy and probably worked there since his mid-teens.[13] They were all working at a place where the Houghton County Mine Inspector had been but a few days before. The Inspector had "looked it over" and had concurred with the work being done. The concurrence did not foresee the next air blasts, which could not have been more poorly timed.

The timbermen were working at the site of an old loading chute, cut into the hanging wall just above the shaft. The fire had destroyed the original timbering at the mouth of the chute that held back the poor rock that had been dumped into it. Without new timbers, that debris could fall onto the rebuilt track. The team had just placed two big posts across the chute when a series of air blasts struck, causing an immediate rock fall.[14] Not only did a part of the hanging wall or shaft roof fall in -- the broken poor rock in the chute also came down, killing seven men in the worst accident ever at Quincy. Ironically, the poor rock in the chute had been put there to help stop any shaft fire. That rock was supposed to have fallen out when the timbers in front of it burned, and by doing so it was to have blocked off the shaft and stopped the fire's spread. But the rock fell too late and buried men instead, some of whom were not killed instantly, prompting frantic rescue efforts. But the air blasts rumbled on, and smaller rock falls injured several rescue workers and chased them out of the mine. When it was over, and the bodies, some crushed beyond recognition, were brought out, the residents of Hancock purchased gold medals for the 70 fruitless rescuers.[15]

The hundreds of air blasts since 1906 had hurt the mine economically, yet they had left the labor force relatively unscathed. Finally they had taken a heavy toll. The large loss of life in this instance only made the air blasts seem more unpredictable, more frustrating and dangerous. The seven dead men must have had nearly 150 years of underground experience at Quincy, yet they had no forewarning. The Mine Inspector did not anticipate the blasts, and Lawton wrote W. Parsons Todd that, "Every precaution that we know of was being taken. . . . We simply didn't foresee it."[16] Lawton went on to write that, "It does seem as though the 'Fates' were against us, and yet we can carry on and recover the shaft and make it solid and safe for the future. . . ."

There seemingly was no end to Quincy's determination to keep the mine open. The Oct. 29 air blasts and rock falls that killed the seven men were not isolated events. For a half year after the fire, air blasts rattled the mine and did great damage. But they came so heavily, were so extensive, that they seemed to offer yet another glimmer of hope. Perhaps the hanging wall had finally "come home":

> This caving or rock failure. . . seemingly spread to other sections and a general failure of stope pillar supports started throughout the worked out portions of the mine. This caving continued intermittently over a period of six months. Apparently all the stope pillars in the old worked out portion of the mine that were left as far back as twenty years ago, have crushed,[17] and now may have about come to equilibrium and rest.

That was the bright side of the picture. On the dark side, the blasts severely hindered the recovery of No. 2, and rock falls tightly choked the shaft over a long length. No. 2, in fact, remained out of commission for nearly a year and a half, from July 13, 1927 (the day of the fire) until January, 1929. The total cost of recovering No. 2 reached $264,000.[18]

No. 2 was down for all of 1928, and in that year Quincy's production plummeted to 1.2 million pounds of copper. In seventy years Quincy's production had never been so low. But the cause by no means rested just with No. 2. Quincy virtually discontinued production to "devote every effort to opening the mine as rapidly as possible for operation on the retreating system."[19] In short, stoping ceased, and Quincy pushed shaft-sinking and drifting, along with the recovery of No. 2 and the reopening of the No. 8 shaft. The change to retreating had been announced in the 1927 Annual Report:

> The retreating system will provide for broader operations along lines of greater capacity of production at markedly lessened cost per pound of copper; furthermore, under this system of mining all of the drifts will be driven to the boundaries of the territory served by the shaft. On completion of this drifting, actual stoping or mining out of the copper rock is begun at the outer boundaries. As the stoping and mining proceed, the work retreats towards the shaft. The small pillars left and the hanging wall are allowed or forced to cave in small sections as the lode is taken out. Thus, many large pillars over an extensive area will not be left to fail and cave at one time. The new system of mining will not permit large pillar failures like those that have occurred during the past six months, and the workmen will have at all times a safe retreat through the drift back to the shaft.[20]

So Quincy finally moved to the system it had first contemplated ten or a dozen years earlier, but had abandoned because of the high development costs involved. But it had gotten to the point where Quincy had little choice but to switch from pillar and stope mining to retreating, except north of the No. 8 shaft, where air blasts had never been a problem.[21] It was either that, or close down.

In the end, simply closing down would have been the wisest choice. To repair No. 2, reopen No. 8, and prepare new, long drifts for starting on the retreating system, Quincy spent a total of $1.6 million by the end of 1929.[22] Production only crept up to 10.9 million pounds by 1930 -- and then the mine finally closed in 1931, before an benefits from this last burst of investment could be reaped.

Ventilation, like the air blasts, remained a problem throughout this period. The air quality at Quincy remained good, but the temperatures generally were too high. The first known analyses of Quincy's air were made in 1930 by the Bureau of Mines. G.E. McElroy took the samples in preparation for writing an article on "Natural Ventilation in the Michigan Copper Mines." Two samples showed no traces of hydrogen, carbon monoxide, or methane,[23] and McElroy wrote Lawton that, "they both show air of very good quality. . . ."[24]

Temperature and air movement were of greater concern than the air's constituent gases. The Bureau of Mines had said that "above 85 degrees in uncomfortable under any air condition," and the temperature in Quincy's working stopes by the late 1920s would "average 90 degrees."[25] Air temperatures at the shafts -- at least the downcast shafts -- could be a considerably cooler 75 degrees, but getting the air to freely circulate through the stopes proved difficult.

Natural ventilation, as always, was the primary means of circulation.[26] The natural drafts were generated within the mine by differences in the densities of air columns in different places, and the differing densities were due mainly to differences in air temperatures. Still, natural ventilation at Quincy clearly did not suffice by itself, and the company added to its complement of electric fans. By 1928 eleven units were underground, and the development work begun in that year for the retreating system prompted Quincy to purchase seven Anaconda-type 4A Siroccos.[27] These forced air through flexible tubes 500 to 2,000 feet long, carrying it to the working faces of new drifts.

In addition to the fans, Quincy ran its compressors continuously (save for Saturday nights and Sundays); whenever the drills were not in operation, the compressed air simply discharged into the mine without powering any equipment.[28] Aside from these measures, there was little else to be done, and Lawton and the mine managers lived with the knowledge that high temperatures hindered the productivity of the labor force. The full extent of that hindrance could not be measured. But in 1927 Quincy noted that it could not hope for two trammers, shoveling rock, to fill more than six cars per shift, "while in many mines they are getting from ten to twenty-five."[29]

During this period of retrenchment, Quincy was naturally loathe to make large expenditures for equipment. Yet it wanted to keep operating and to cut operating costs whenever possible, so such expenditures could not be entirely avoided. Sometimes the equipment in use simply wore out and demanded replacement. Other times, Quincy had to spend money to save money; it had to invest in new equipment whose operating costs promised to be lower, or which promised to increase productivity.

Both wear and obsolescence apparently struck at Quincy's complement of air drills. At the beginning of this period, the dominant machines were the No. 26 Leyner Ingersoll drills, purchased in c. 1913-1915. At least by 1922, Quincy was seeking a substitute. It tested the Leyner Ingersoll against the one-man, Cleveland 3 M 50 drill, which outperformed it. The Cleveland machine, on average, drilled $3^3/_4$ inches per minute; the Leyner Ingersoll, $2^3/_8$ths.[30] Still, it appears that Quincy put off investing in new drills for some two years, and then it did not turn to the Cleveland machine.

In 1924 Quincy purchased 51 "higher powered" rock drills, and in 1925 it added 53 new 3" piston rock drills and 20 new $2^5/_8$ th inch piston drills.[31] These replaced all of the old $2^1/_4$" piston drills in the mine, plus a number of the old $2^5/_8$th inch drills.[32] For an expenditure in that year alone of $30,000, Quincy was getting not only new equipment, but more powerful machines due to their larger-diameter driving pistons. In the following year, Quincy added another 45 new drills, making a total of 147 machines purchased in 1924 to 1926.[33]

The 3" drill that dominated at Quincy after 1924 was the

Chicago Pneumatic. Between July 1924 and March 1927, Quincy purchased 136 of this model at $335 each, for a total of $45,560. Quincy's 20 new $2^5/_8$" drills may have been L-70 Ingersoll Rand machines, whose total cost was $5540. The only other machine type known to have been acquired by Quincy during this period was the Ingersoll Rand L-71, ten of which cost $3100.[34] To take greatest advantage of the new, larger Chicago drills, Quincy replaced smaller compressed air power pipes in the mine with new 4" pipes, thus "reducing friction and giving increased air pressure at the machines."[35]

Another type of drill done in during the retrenchment, at least for a while, was the diamond drill for explorations. Quincy stopped using its two machines in September 1920 to save on their operating expenses. Apparently this was done at the request of the New York officers, and Charles Lawton was not in agreement. He saw the stoppage of diamond drilling as an exercise in false economy, and early in 1922 he wrote W. R. Todd regarding the diamond drill: "We save money and make money by the result of its use."[36] Lawton argued that the expense of diamond drilling was relatively small, yet Todd apparently continued to believe that that expense should be trimmed.

The biggest change in mucking out rock at Quincy had occurred in the late teens, when it started using scrapers, small tugger hoists, level loaders and other mechanical aids. The biggest change in tramming had come in 1901, with the advent of electric locomotives. No such "revolutionary" changes of equipment occurred from 1920 to

1931, but Quincy did augment and upgrade some of the machinery that it used. In some instances, the company found it more economical to run small electrically powered winches or tuggers underground, instead of the earlier, air-powered variety. And in 1930, as noted in the last chapter, Quincy installed some conveyors underground and claimed that they increased the tonnage trammers could handle by up to 100 percent.[37]

Many of the units in Quincy's stable of electric locomotives had grown quite old; indeed, in 1927 the mine still used ten of the very first General Electric trolley-wire locomotives that it had purchased. These were a known liability. They were "so obsolete" that G. E. made no replacement parts for them whatsoever, and Quincy had to rely on its own machine shop to keep them going. Also, "the power of these old motors" was "sufficient to haul only three tram cars, whereas a big Jeffry locomotive hauls six or seven"[38] Quincy even admitted that "there are no such obsolete motors in operation in the (Michigan copper) district," yet it was not fully willing to make the investment needed to upgrade this equipment.[39] In 1922, four-ton battery-powered locomotives would cost $4,900 each; four-ton trolley locomotives, $3,200. Finally, in 1930, Quincy did purchase two new 5-ton locomotives, and it remodeled four older machines, doubling their weight and increasing their power from 50 to 200 percent.[40]

The technology of mucking and tramming, of course, did not consist solely of machinery. It included the men -- and the manner of organizing the men and the machines. One benefit expected to be reaped from the retreating system was a more harmonious working relationship between miners and trammers. Under the old advancing system, they could get in each others' way. The drifts had to service the drifters, working out ahead, and the stopers, working behind. When a stope from a lower level broke through, for example, there was "always a large pile of broken rock on the track."[41] That rock hindered the tramming of rock broken further out along the drift, and this slowed development work. With the retreating system, all the development work would be gotten done first, with no interruption due to the activities of stopers.

Quincy seemingly made another important change in its manner of organizing drifters and trammers in 1926-1927, although it is not clear if it put this change into effect throughout the mine.[47] Previously, in most drifts a single miner worked each shift, supported by a small team of trammers. At the close of a shift, the miner blasted and went home. When the next miner came to work, all the debris was in his way. He had to muck out the rock at the very end of the drift just to set up his machine and go to work. That cut his drilling time and meant that some of the broken rock was handled twice: first by the miner, who cleared it away enough to work, and then by trammers who cleared it away altogether.

Quincy decided not to mix the drifters and trammers on the same shift. It put two miners and two drills on one shift. They drilled, blasted, and went home. Then the trammers came in on the next shift and thoroughly mucked out the drift. When the two miners returned, they could go straight to their machine work, because no rock was in their way. Under the old system, a miner averaged 3.02 feet of advance per day, at a cost, per foot, of \$6.25. With the new system, miners averaged 4.42 feet, at the reduced cost of \$5.45.[43]

In the matter of hoisting, the most significant change involved the means of unwatering the mine. Quincy went far more heavily to electric pumps, eliminating the use of hoisted bailing skips.

This change was abetted by a change of the surface. As mentioned previously, in the 1905 to 1920 period, Quincy had become more energy conscious, as best exemplified by its switch to compound-condensing hoist engines. This concern for energy costs intensified as Quincy became unprofitable. In 1923 Quincy put a low-pressure steam turbine into operation at its stamp mill on Torch Lake, and this had important ramifications at the bottom of the mine in 1926.

The turbine, installed at a cost of \$117,500, used the low-pressure steam exhausted from the mill's huge steam stamps to generate electricity. In 1924, at the additional expense of \$13,250, Quincy ran a transmission line from the mill to the mine. Prior to installing the turbine, Quincy had been largely dependent upon the Houghton County Electric Light Company for its electricity. The power Quincy purchased had cost .02 cents per kilowatt hour; the power it now generated for itself cost .004 cents.[43] By 1926 Quincy was using 6.3 million kilowatt hours, and saving about \$103,000 annually in the process. The reduced cost of electricity encouraged Quincy to expand the use of underground electric pumps and to install much large units there.

As Quincy itself noted, "It seems almost unbelievable that a mine. . . , having been in continuous operations for upwards of seventy-five years, and having reached one of the greatest depths of any on earth, has made this great accomplishment by the use of bailers for handling the underground mine waters. . . ."[44] Underground, Quincy had used gutters or pumps and pipes to channel water to sumps, and when these were nearly full -- and when it was convenient, such as on a Sunday -- it had used its bailing skips to haul the water up and out. The bailing skips were essentially just wooden boxes on skip-wheels. That Quincy was having more problems with water could be seen in 1924, when it increased the bailing skips' capacity by 50 percent, and started using two bailing skips in tandem on each end of a hoisting rope.[45] This meant that its balanced hoists operated four bailers at once, instead of just two. In that year, to keep the mine dry Quincy hoisted a high of 34,041 water skips. Figuring 1,000 gallons per skip, that amounted to the not inconsiderable amount of 34 million gallons of water.[46]

The main problem with the bailing technology was that it interfered with rock hoisting, unless it was restricted solely to Sunday. The two systems shared the same engines, ropes, and skip tracks. Only the skips themselves were changed over from hoisting rock to hoisting water. To free the hoists for stamp rock, and at the same time to realize savings, Quincy in 1926 eliminated its bailing skips. At a cost of $46,000 it ran electric power down into the mine, connected it to two large Blake pumps, and ran piping back up and out of the mine.[47] The pumps were installed at the No. 6 shaft. The bottom pump, at the 82nd level, pumped up to the 46th level, where a second Blake machine pumped the water to the surface.[48] Due to the vagaries of cost accounting, a direct computation of the savings effected by the use of the large pumps was difficult to make. But Quincy reported an annual savings of "something like $21,300."[49]

The pumps were not the only electrical innovation that allowed for the more efficient use of the equipment for hoisting rock. Virtually from the beginning, Quincy's fillers, landers, and hoist engineers had communicated by a pull-rope and bell system. In 1924 the company spent $5770 to install an electric bell and light signal system in No. 2, which also included a new telephone line. In the next year, Quincy followed it up with a $3750 system in No. 6.[50] Here was a simple, relatively inexpensive improvement that seemingly could have been made years earlier. The electric signals traveled faster between the hoisting participants, and thus reduced the time that the machinery sat idle. They "eliminated many delays in hoisting," which "had become absolutely necessary and essential in order to increase the production in the future operations of the mine." While any exact time savings resulting from this change is unknown, in 1925 Quincy opined that faster communications would increase the hoisting capacity at a shaft "between one and two hours a day," and in 1927 it estimated an annual savings of $10,000 due to electric signals.

Technological change on the surface was not very great during this period. Quincy still largely went with the support service facilities constructed in 1892 to 1905. Wear, obsolescence, or inadequacy motivated those changes that were made.

The Hartford Steam Boiler Inspection and Insurance Company pushed Quincy to make one change. The No. 2 and No. 6 boiler plants had been in service for over 25 years, and the insurance company reduced their allowable steam pressure. This encouraged Quincy to replace them in 1926-1927 with its last new boiler house, located near the No. 6 shaft. This improvement cost the company over $40,000.[51] The boiler house included four Babcock & Willcox 650 h.p. boilers, tested and approved for 200 pounds, and equipped with mechanical stokers. Quincy deemed the new boilers far more fuel-efficient and less expensive to operate than the two older, separate units. In fact, it expected that the savings accrued from the first year of service would equal the boiler's cost.[52]

The No. 8 shaft, after being mothballed for about six years, was reopened as part of the major effort after 1927 to put the mine on a sounder footing, largely by going on the retreating system. No. 8 would give Quincy another entrance to the copper, should more disasters crush and close Nos. 2 or 6. Also, during the several-year's process of switching totally to retreating, No. 8 -- shallower than the other two shafts and unaffected by air blasts -- would allow Quincy to keep up a respectable copper production. Those levels north of No. 8, at least, would recommence operation on the old pillar and stope system.[53] They would yield copper rock, while throughout the rest of the mine, stoping would largely give way to drifting and shaft-sinking.

The most significant surface rehabilitation work needed to reopen No. 8 was at the shaft-rockhouse. No. 8 was an upcast shaft, and six years of damp air had filled a structure receiving scant maintenance. The timber structure over the shaft had decayed and needed replacement. Quincy once again exhibited its mastery at making do with something old, of reusing something on hand. Instead of building a new No. 8 shaft-rockhouse, at a cost of $20,000 it removed the steel-frame structure from No. 7 and reerected it at No. 8.[54] The shaft reopened in August, 1928.

The hoist at No. 8 did not require major service to put it back into operation. Indeed, it had been reworked in 1922, just before Quincy had closed the shaft. In 1920, after installing the new Nordberg hoist at No. 2, Quincy had turned its attention to No. 8. The extant engine -- which Nordberg had previously modified to make it compound and condensing -- could reach the 75th level -- a depth Quincy expected to reach in 1922. The plan was to take the old No. 2 Allis duplex hoist and put it at No. 8, and foundation work needed to make the switch was underway in mid-1920.[55] At the same time, at Quincy's invitation, Nordberg was preparing a proposal to remodel the used hoist. It must have been a complete remodeling job that Nordberg had in mind, because the proposed cost was $154,000.[56] In better economic times, Quincy might have contracted for the work, but not now. Lawton began favoring the notion of simply moving the 1894-1895 engine without changing its works. That operation alone would cost some $50,000.[57]

Ultimately, even a simple move of the No. 2 engine came to be deemed too expensive a means of getting 1000 feet or so greater capacity at No. 8. Quincy decided to keep the engine it had at No. 8, but to replace its conical drum with a lighter, smaller-diameter cylindrical drum built by Allis-Chalmers. By winding the hoist rope in multiple-layers on the drum -- winding the rope over itself -- in 1922 Quincy got the additional depth it wanted at a cost of only $11,000.[58]

Two aspects of this move at No. 8 bear noting. First, Quincy's suddenly poor economic condition seemingly made the mine management tentative and hesitant -- and ready to make-do now with less than the best at its hoist plants. There was quite a falling off from the monster, fully-modern hoist at No. 2 costing $371,000, to the $11,000 drum at No. 8. And Lawton seems to have agonized unduly over the choices, taking almost two years to sort through his options, and fretting greatly over whether Quincy should finally get the $11,000 Allis-Chalmers drum, or a $19,000 drum proposed by Nordberg.[59] Uncharacteristically, he kept hedging on his decision, throwing the matter to the New York officers. This finally prompted W. R. Todd to write Lawton:

> We . . . cannot understand why you should expect us to be in a position to decide engineering problems. In the case where two reliable manufacturers are figuring on different installations to meet our requirements, it is a matter that we must necessarily leave to you, our master mechanic, and an engineering force to decide. . . .[60]

Secondly, the installation of the drum pointed up another Quincy problem: a labor scarcity. The hoist drum became a pawn in the game of labor management. Lawton had the drum on hand and was ready to install it in June 1922, which of necessity would have required a cessation of work at the No. 8 shaft. Then he got a letter from W. Parsons Todd:

> On account of the restlessness of labor and the importance of holding our entire underground force, we are a little uncertain as to the wisdom of making this change at the present time. From past experience a number of the underground men seem to object to going down No. 6, and the closing down of the shaft (No. 8) for ten days or two weeks might change the normal life of the men just enough to induce some of them to start for the automobile section (Detroit) or hunt up a job at one of the adjoining mines.[61]

Todd's idea was to delay the change until September, when winter would be coming; men would be less likely to leave their snug Quincy homes; and work in Detroit's auto factories would be slower. Lawton agreed to the delay.

The No. 2 hoist plant, of course, needed no improvements through this period. That was not true at No. 6. In 1926, when the shaft was about 7650 deep -- a depth it had been at for three years --[62] Quincy lagged its drum with 4" thick hard-wood, increasing its diameter by 8 inches to 23' 2". That bought a few more years' time for the 34-year-old Allis duplex engine and its 24-year-od cylindrical drum.

No doubt for the sake of economy, Quincy in 1928-1929 chose to modify the No. 6 engine extensively, reather than go with an entirely new one. Again it turned to Nordberg for the work. Nordberg's proposal of Oct. 30, 1928 called for a new drum at No. 6, and for making the engine (then a simple duplex) into a duplex tandem compound: two in-line cylinders (one high pressure, one low pressure) on each end of the drum.[63] The drum itself, 18' in diameter, was smaller than the one it replaced. But unlike the old one, the new drum, with a flange in the center, was designed to carry 4 to 6 layers of $1^{1}/_{2}$" rope, rather than just one. This gave the increased depth capacity of up to 13,000 feet.[64] (This was the same depth obtainable with the Nordberg No. 2 hoist, if a single layer of $1^{5}/_{8}$" rope was carried on the drum's cylindrical section and on both conical ends.)

The remodeled engine alone cost approximately $78,000; the total expense of re-equipping and enlarging the No. 6 hoist house ran to $102,000.[65] The work was completed in 1929. It took some time to work the bugs out, but Quincy, overall, was satisfied:

> The remodeling and modernizing of such an old hoist for the purpose required is not an exact science, for quite a number of the features are more or less new, and it required considerable study, ovservation and adjustments. However, it was quite worthwhile, for the economical result has been satisfactory. There was a large saving in expense over the purchase of a new hoist of like economy for the greater depth.[66]

In 1930, Quincy was close to 9000 feet down with No. 2 and No. 6; a little over 7000 feet down at No. 8. It was the deepest mine in the United States.[67] It had been struggling for a full decade -- a decade that brought no profits, and had been marked not only by economic problems, but by the day-to-day frustrations of labor problems and the random calamities of air blasts.

The remarkable thing was that Quincy had not outright quit. Nor had it buried its head in the sand, waiting for problems to go away, for copper prices to go up. The company, of course, had to conserve on its capital expenditures -- this was no time to lavish money on new hardware -- yet it did not try to ride out its problems, in the meantime watching its physical plant and machinery simply wear out or become obsolete. Internally the company was in quite good condition in 1930. It had three hoists fully capable of working long into the future; it had a new boiler plant at the mine, and the electrical generating plant at the stamp mill. Several new locomotives worked underground, plus a relatively new complement of air drills. And of course, the switch to the retreating system was well underway, and production was rising again.

Quincy had not fallen into a pathetic decay, but had looked after its needs. Quincy probably thought it had turned a corner in 1927-1929 with its considerable infusions of capital, and perhaps it had. But it ran smack into the Depression. In 1931, after most Michigan mines had already closed their doors, Quincy, too, finally capitulated. The mine closed, after seventy-five years of exploiting the Pewabic Lode.

It was not an internal failure or a lack of copper that caused the closure. Quincy admittedly was a high-cost producer; at its depth, that was inevitable. Yet it was the externals that did the company in: a low copper market and the general collapse of the economy. Quincy would try it again, briefly, from 1937 to 1945, when it reopened the mine on a limited basis. But with the end of World War II and government price guarantees for copper, Quincy closed its mine on the hill above Hancock for good.

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NOTES -- CHAPTER V

1 See QMC Annual Reports for these years.

2 QMC 1922 Annual Report, p. 13.

3 QMC 1923 Annual Report, p. 12.

4 QMC 1924 Annual Report, pp. 11-12.

5 Lawton to W. Parsons Todd, April 11, 1927.

6 Lawton to W. Parsons Todd, July 13, 1927.

7 Gregory and Martinson, U. S. Bureau of Mines report on the Quincy fire, ms found in QMC company records.

8 Lawton to W. Parsons Todd, July 25, 1927.

9 W. Parsons Todd to Lawton, July 21, 1927.

10 Daily Mining Gazette, July 22, 1927.

11 QMC 1927 Annual Report, p. 12.

12 Ibid., pp. 12-13.

13 Daily Mining Gazette, Nov. 1 and 2, 1927; Mine Inspector's Report for Houghton County, 1927-1928, pp. 5-7.

14 Daily Mining Gazette, Oct. 30 and Nov. 1, 1927.

15 Ibid., Nov. 5, 1927.

16 Lawton to W. Parsons Todd, Oct. 31, 1927.

17 QMC 1927 Annual Report, pp. 12-13.

18 QMC 1929 Annual Report, pp. 6, 10.

19 QMC 1928 Annual Report, p. 6.

20 QMC 1927 Annual Report, pp. 13-14.

21 McElroy typescript, "Quincy Mine," originally written for his article on "Natural Ventilation in the Michigan Copper Mines." Found in QMC company records, the text on Quincy was not included in the publication, Lawton squelched the section, because it captured Quincy at its nadir and therefore was not representative.

22
QMC *Annual Reports*, 1927-1929, *passim*.
23
U. S. Bureau of Mines, "Gas Analysis Reports, Nos. 52833 and 52834." Found in QMC company records.
24
McElroy to Lawton, Sept. 5, 1930.
25
QMC, "Surface and Underground Materials."
26
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27
Ibid.
28
QMC, "Surface and Underground Materials."
29
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30
F. C. Schwarzenberg to Lawton, Feb. 4, 1922.
31
QMC 1924 *Annual Report*, p. 13.
32
QMC 1925 *Annual Report*, p. 14.
33
QMC 1926 *Annual Report*, p. 12.
34
QMC, "Construction, Repairs and Renewals and New Equipment, July 1, 1924 to Mar. 1, 1927."
35
QMC 1924 *Annual Report*, p. 13.
36
Lawton to W. R. Todd, Jan. 6, 1922.
37
QMC, 1930 *Annual Report*, p. 13.
38
QMC, "Surface and Underground Materials."
39
Ibid.
40
QMC, 1930 *Annual Report*, pp. 12-13.
41
QMC, "Surface and Underground Materials."
42
Ibid.
43
Ibid.
44
Ibid.

45 QMC 1924 Annual Report, p. 13.

46 QMC, untitled computation of bailing performance, 1911-1926.

47 QMC, "Construction, Repairs and Renewals...."

48 QMC, 1926 Annual Report, pp. 12-13.

49 QMC, "Surface and Underground Materials."

50 QMC Annual Reports: 1924, p. 13; 1925, pl 15; Also see "Surface and Underground Materials" and "Construction, Repairs and Renewals...."

51 QMC, "Construction, Repairs and Renewals...."

52 QMC 1926 Annual Report, p. 14.

53 McElroy typescript, "Quincy Mine."

54 QMC Annual Reports: 1927, pp. 11-12; 1928, pp. 6, 12-13.

55 Lawton to W. Parsons Todd, July 13, 1920.

56 Lawton to W. Parsons Todd, Sept. 7, 1920.

57 Lawton to W. R. Todd, Nov. 22, 1921.

58 See numerous letters: Lawton to W. R. Todd, Oct. 31, Nov. 22 and Dec. 21, 1921 and Jan. 11, 1922. Lawton to W. Parsons Todd, Nov. 7 and 15, 1921; W. R. Todd to Lawton, Jan. 19, 1922.

59 Lawton to W. R. Todd, Jan. 11, 1922.

60 W. R. Todd to Lawton, Feb. 2, 1922.

61 W. Parsons Todd to Lawton, June 30, 1922.

62 QMC, "Shaft Data" card file, 1923-1926.

63 Nordberg Proposal No. 2818, found in QMC company records.

64 QMC, "Shaft Hoist Data -- No. 6," 1927.

65 QMC 1930 Annual Report, p. 13.

66 Ibid.

67 McElroy transcript, "Quincy Mine."

"Quincy Mining Company: Housing and Community Services, c. 1860--1931"

by

Sarah McNear

INTRODUCTION

A basic ingredient of all industrial endeavors is the labor force. The supply of labor is determined by a number of contributing factors, all of which vary from industry to industry. Geographic location is one such factor. If location can be controlled, a company can arrange to be situated near an adequate supply of labor; for instance, in or near a major metropolitan area. If on the other hand a company's location is restricted, then the company must attract workers and create its own labor force. The Quincy Mining Company and its site specific operation was illustrative of the latter situation.

In the early years, for that matter throughout the history of the Upper Peninsula, the inadequate supply of labor was a major problem for the mining companies. The seclusion and climate of the region were primarily responsible for this fact. It has been suggested that Europeans knew of the copper deposits in the Lake Superior region as early as 1777, but the harsh winters impeded their early exploitation. During the 1840s and early 50s the supply and demand of labor remained seasonal. Production always fell off in late winter when the permanent labor force was depleted and the arrival of reenforcements rendered impossible by the frozen water routes.

For these reasons most of the mining companies, Quincy included, found it necessary to create habitable communities, offering all the life supporting services, in order to attract and maintain a labor force. As will be seen, Quincy's definition of life supporting services included, over the years, 1) an extensive housing, boarding, and land lease policy which offered men a choice of living arrangements suitable to their personal wants and needs, 2) complete medical service, which began as a simple concern with mining accidents, and grew into a family oriented organization which practiced and preached preventive medicine, 3) a company store, which supplied miners with basic necessities at lowered prices, 4) schools, which were theoretically a charge of the township, but in reality a service supported and managed by Quincy, 5) a company club house which housed bathing facilities and reading rooms, and 6) a variety of philanthropic activities such as accident compensation, holiday celebrations, and church related services.

When combined, these six factors worked in the company's favor. Although there is no quantitative proof that they actually attracted men to the location, they certainly served to create a viable community which must have inspired stability in the labor force. The Quincy administration was at all times concerned with the industry and integrity of their men. For example, the company favored the erection of single family houses rather than boarding houses because experience proved married men to be more reliable than single men. And in July 1918, Charles Lawton, mine superintendent, wrote Parsons Todd, vice-president of Quincy, in reference to the employees' gardens, suggesting that the company had to build fences around the little gardens, it being, "essential to the general morale of labor force."

Much could be said about historical precedence relative to Quincy's labor relation policies. Certainly much could be made of Robert Owen, Lowell, Massachusetts, and other nineteenth century theorists and like endeavors. Although Quincy officials may have had these ideas and examples in mind, they were responding, firstly and foremonst, to the economics of their situation. In the long run, Quincy's officials did very little theorizing. Their actions reveal concern with economic factors. Their words, benefiting from hindsight and economic relief, reflect real and practical thoughts concerning the company's policy"

> In years past many customs that we now follow seemed actually necessary. I remember the time we had little or no currency in the country, with no bank facilities. Now as I have often said, and it has got to be tiresome with me, please do not refer to old customs that have passed. Many are dead and should be buried, but look to the future and be governed by experiences. We must favor any changes that will provide future benefits.

In this letter to Charles Lawton, William Todd, Quincy's president, advised that some of the old policies were no longer necessary, and that they should be discontinued, possibly to be replaced by new services more relevant to the current needs of the labor force.

The question which so readily presents itself is, of course, were these services and Quincy's policy in general paternalistic, and if so, what was their qualitative effect? Paternalism is not easily defined, let alone measured. It is at all times closely linked to the intentions and attitudes of all parties concerned, in this case, the Quincy administration and the labor force.

The record shows that the policies of Quincy were essentially paternalistic, that is, they tended to govern the labor force in a manner suggesting the relationship of a father and his children. In many cases, the particular policies actually served as social and financial controls over the men. This fact, coupled with Quincy's involvement with school, township, church and other social matters clearly reflect a paternalistic attitude on the part of Quincy officials. The attitude of the labor force is more difficult to determine since acceptance of the service may reflect little more than the lack of a viable alternative. The qualitative effect of this paternalism was neight good nor bad, it served a purpose at the time, and eventually this purpose was out-grown. The change in attitude could be attributed to both local and national factors. Management became less enchanted with these activities once a permanent population had been established, and the labor force was less dependent on the good graces of their employer. Recent strikes in the mining region also served to hasten this change in attitude. On the national level, capitalists were observing the growth of the welfare state and were not pleased. William Todd wrote Charles Lawton in 1916 in reference to what he saw as a national trend:

> .....but all this is not peculiar to Houghton County. I know it extends to a much larger field, particularly to the United States Government which is drifting along what may be called a paternal government and the children or citizens expect to be taken care of accordingly.

QUINCY HOUSING

Providing an adequate supply of housing was foremost on the Quincy Mining Company's list of priorities in its attempts to attract and maintain a permanent labor force. Housing near the mine was to dispell any doubts about settling in the area and to serve as an attraction to potential employees. The housing policy at Quincy was relatively simple in conception and changed very little over the years. Men could exercise four options: 1) they could live independently of the company in privately arranged housing in Hancock; 2) they could build their own houses on land leased from the company; 3) if single, they could live in company boarding houses, or 4) they could rent a company-owned house.

For both the management and employees, the status of each option changed throughout the active history of the mine, 1848-1931. For the sake of clarity, it is best to divide this 83-year period into three phases, each of which was marked by major housing construction booms. The earliest phase extended from the first year of operation, 1848, through 1872, when A. J. Corey became agent at Quincy. The middle period ran from 1873 through 1900. The late period extended from 1901 up to the mine closing in 1931.

The early phase was the most critical, for it was during these first twenty-four years that the company housing policy was defined and instituted. As previously discussed, the physical conditions on the Keeweenaw Peninsula represented the primary impetus for initiating company services such as housing. The company felt the weight of this particular difficulty from 1848 through the 1860s. For this reason the status of the four options during the earliest period serves as a base of comparison for succeeding years when conditions became relatively relaxed.

It cannot be determined how many men in a given year chose, or were forced to choose, the first option. It can be reasonably assumed that Quincy rarely had a sufficient number of living units at the location to house all of the hired men. Many had to arrange for accommodations in the village. Most of the operatives at the first Quincy Stamp Mill, which was built in 1859 and located on the shores of Portage Lake, lived in the village. [1] Hancock was built entirely on what was once Quincy-owned land; it was not actually platted until 1859. From 1846 through 1854 there were only a few log structures standing in the area [2], which suggests that prior to 1860 the village afforded the Quincy employees with little in the way of private housing. But by 1860, Hancock's population had increased to 1,618, and this had almost doubled by 1870. Quincy had sold off some of its land by the lake so that Hancock had grown "to quite a pretentious size." [3] It can be assumed that by this time many men were able to find accommodations in the village, either in small privately run boarding houses or individual houses.

It is difficult to differentiate between houses built on privately-owned land and those built on leased Quincy land. By 1862 at least 41 houses stood on leased lots in Hancock. [4] Some of these were probably located in "Shantytown," a small neighborhood situated just north of the village proper, half way up the hill. [5]

Although it is difficult to determine exactly which houses were on leased land and which were not, there was a wealth of difference between the two types. A tenant on leased land was subject to restrictions which increased over the years. In 1863 the company was issuing a 99-year lease for certain lots in Hancock at $100 each. This lease retained the mineral rights for Quincy and restricted the sale of alcoholic beverages on the premises. The tenant assumed all tax responsibilities and was subject to forfeit if they were not fulfilled. However, unlike leases issued in later years, this document was transferable if the original tenant so desired. [6]

Building a house on leased land was an option open to employees and non-company related individuals. The tenant had to be wealthy enough to carry the ground rent, the taxes, and the cost of constructing a house. If he could afford this he could enjoy the benefits private homeownership offered. As will be seen, these benefits gradually diminished, and Quincy changed its lease policy.

By far the most popular option, or at least the most expedient during those earliest years, was the company boarding house. Mine plants in their infancy have been described as consisting of "a small farm, a blacksmith shop, a carpenter's shop or a small saw mill, a log bunkhouse or two, a store house, a rock house, and sometimes a stamp mill." [7] This is probably an apt description of the Quincy location prior to 1856. The bunkhouse was most certainly the first company-built housing on the location, although this cannot be documented for Quincy. Still, it follows that company housing would be more economical and convenient when housing the early miners, most of whom were single. [8]

Separate from a bunkhouse, the boarding house supplied men with a bed and their daily meals. In 1852, a board charge of 33 and 1/2 cents a day, approximately $10.00 a month, was deducted directly from each individual's salary. [9] This rate increased to 39 cents, or $12.00 a month, by 1859. [10] In 1862, there was only one boarding house on the Quincy location; it held approximately 40 to 50 men. [11] Two years later Quincy built a second house and paid Bradford Grimes $800 a year to run it. [12] This practice of hiring a boarding housekeeper was common and continued throughout the company's history.

These two houses were not the only boarding accommodations available during this early period. There were private houses in the area that took from 1 to 40 men as boarders. In 1861 there were 82 such institutions housing approximately 350 men. [13] Although most of these accommodations were arranged for privately, many of the housekeepers rented their homes and boarding facilities from the company, thereby linking them with the company. All of the keepers collected their boarding fees at the mining office where, again, it was drawn directly from the individual's pay. [14]

For most men with families, the company rental properties afforded the most attractive housing option. In the earliest period the quality of the housing was good and management covered the cost of all repairs. The majority of the dwellings were conveniently located, and their closeness to the mine made them that much more attractive. In 1853 a house rented for $1.00 a month. But this rent soon increased to $1.50 and then to $2.00. In later years, rent was charged at a rate of $1.00 per room. [15] Although subject to the company's rules and watchful eye, most employees probably found the housing more than adequate.

Company built, owned, and rented houses were the principal components of the housing policy. Representing an additional, and by no means meager, expenditure, the houses were never built for speculative purposes. They were a necessary part of the physical plant--ultimately, though not directly, connected with the production of copper. This raises the question of the overall cost of the housing policy versus its returns. Although a simple mathematical equation in one regard, the final returns received were immeasurable. These came with the establishment of a stable labor force which would, hopefully, maintain or increase a certain production level. If company housing successfully lured and held a productive labor force, then the initial investment was well spent.

Such a qualitative factor is difficult to measure. The maintenance of the labor force was connected with the housing only to the extent that there was a sufficient supply of adequate, cheap accommodations to attract and serve the needs of that force. At no time did the housing policy serve as a direct control over labor, except in individual eviction cases.

The total cost of the housing was the sum of two factors. Firstly, the cost of construction, which in the 1860s ranged from $40.00 for a single log dwelling to a couple of thousand dollars for a large official's house; [16] and secondly, the cost of repairs and maintenance, which was a perpetual, ever-increasing drain on the yearly dwelling account. The most extravagant aspect of the housing policy was supplying the mine officials with custom-made houses free of charge. From at least 1857 on through the first period (and even the second), the company pursued a strategy which funded the construction, and in some cases the furnishings, of several houses intended for specific officials. [17]

The early record raises questions about the type of housing being built for the regular class of employee and that being built for the mine officials. No doubt the company believed it was necessary to supply officers as well as miners with location housing. It would follow that these houses would be more luxurious than those built for the workmen. The comparative costs of construction suggest a dichotomy of lifestyles which were established early and continued throughout the plant's active history.

Little of_the earliest workers' housing, either privately or company built, survives. It is known that many, if not all of the houses built prior to 1858, were constructed of logs. At least 16 log dwellings were built by the company between 1858 and 1862, and it may be reasonably assumed that others were erected during these years. [18] On later maps, circa 1898, most of these log houses are shown as being randomly arranged and comparatively tiny. [19] The majority had only three to four rooms: one downstairs and two or three small rooms upstairs. Only one six-room log house is known of. [20]

These houses would have been fully finished; that is, the logs would have been hewn square, joined, chinks filled, and covered with clapboarding. On the interior, the walls would have been plastered over and white washed. This treatment succeeded in divorcing the log superstructure from the external guise of the house. Log construction served only as a convenient type of fabrication when the area was lacking in adequate milling facilities. Quincy used log construction for domestic structures into the 1860s.

In 1862, S. S. Robinson, Mine Superintendent, reported that the company possessed 95 tenement houses; this figure included the one large boarding house and all of the single-family cabins. [21] Although it represents the first total house count, this information remains vague because it fails to suggest where these houses were located on the Quincy property. At that time, Quincy owned only the southern-most end of the Pewabic Lode in Section 26; this included all of the hillside down to Portage Lake. [22] Later maps reveal housing arranged in irregular groupings at the top of this slope, along the county road (present clay Route 41) which ran parallel to the Pewabic Lode, and out in the field to the west of the road. These were probably the locations of the earliest housing at the mine site itself.

With the discovery of the rich Pewabic Lode in 1857, [23] and the increasing returns received on that investment, the record reveals a gradual increase in housing construction, culminating in a veritable boom in 1864. In 1862 and 1863 Quincy spent $5,089.41 on officials' houses, and $1,352.85 on employee housing. [24]

Thomas F. Mason, Quincy's President, mentions an endeavor in his 1863 Annual Report which would prompt the construction of many houses at the Quincy plant:

> "The year upon which we have entered promises the most prosperous results, the only drawback being the increasing scarcity of labor....The principal companies

> on Portage Lake have, however, inaugurated a movement for the purpose of bringing over from Norway and Sweden a hardy and industrious class of miners and laborers... [25]

Apparently Axel Silversparre, a Swedish engineer employed by Quincy, suggested that he be sent to Sweden to recruit miners. The proposition seemed attractive because these new men would remain free from conscription in the Union army--an agent which had been tapping the local labor force. Several companies agreed to sponsor him and Silversparre left for Sweden in the summer of 1864. [26]

In anticipation of his return, Quincy built "Swedetown" up on a hill to the west of the County Road, away from the center of the mine plant. Supposedly the older, more xenophobic miners, who would have been primarily Cornish, Irish, and German, insisted that the new "foreign" element be housed in a location separate from the rest of the community. [27] All of the houses in Swedetown were log. [28] The exact number cannot be determined, but in 1864 the company built a total of 37 log houses, most of which were presumably at the Swedetown location. [29] In preparation, the company also built a road out to the location, a stable, and a root cellar. [30]

When Silversparre returned, many of the men who had accompanied him were pirated away by Union recruiters, who offered them an enlistment bonus. It seems that the loss of a good portion of these recruits resulted in the premature abandonment of Quincy's Swedetown location. [31] In his report for 1864, Mason was forced to conclude that the importation efforts had met with "only partial success." [32]

Besides the houses at Swedetown, Quincy built four additional houses for officials, and 68 frame tenement houses for employees. [33] In all, 109 dwellings were built in 1864. The two earliest planned housing locations at the Quincy mine were built in this year. [34] "Limerick" was laid out just west of and parallel to the County Road, at the northeast corner of Section 26 on Quincy's property line. It appears on a contemporary map as consisting of three rows of dwellings: two rows of ten and one of eleven. [35] A 1898 map of the Quincy plant shows only 29 dwellings in total: two rows of ten and one of nine. [36] "Hardscrabble," the second location built in that year, was mapped out parallel to Quincy's northern property line, just west of Limerick, a good distance from the County Road. It is shown on the 1864 map as consisting of four rows with eleven houses each. [37] The 1898 map reveals one row of nine dwellings, facing a row of eleven, and a third row of six dwellings which faces a row of eight. [38]

The placement of these two locations shows forethought in planning. If an outcropping had been discovered at these positions, Quincy could not have sunk a shaft at either point because, once underground, they would have crossed their property line and run into minerals belonging to the Pewabic Mining Company. This made the placement of the housing relatively safe from encroaching mine operations. At the same time, the locations did not interfere with the lode being worked from the other side of the road; the shafts would run beneath the housing locations. This planning contrasts dramatically with the earlier, random placement of houses.

Swedetown, Limerick, and Hardscrabble are illustrative of the company's commitment to its role as employer and landlord. The economic security of the firm in the early sixties encouraged investment in a permanent labor force. This investment included the construction of large-scale housing developments. The fact that single family dwellings were built, rather than large boarding houses, illustrates the company's desire for a more stable, less itinerant class of employee. The arrangement of these houses demonstrates the conscious concern of the management to create neighborhoods within a company community.

The three locations were all conceived of as separate physical neighborhoods, set apart from one another. One explanation for Swedetown's isolation has already been given. Perhaps the same brand of ethnic prejudices, as observed, expected, or felt by the management, prompted them to divide the proposed housing into separate units. Certainly the name "Limerick" implies that the location was at one time heavily populated with Irish families. [39] If ethnicity was a determinant, it probably contributed to inter-neighborhood competition which squelched any larger company-related allegiances.

If on the other hand the decision to build small separate neighborhoods was based solely on practical expediency, it may not have affected ethnic or company-related sentiments to any appreciable degree. In either case, the planning of the neighborhoods did serve to relieve the employee and his family from feelings of extreme isolation. Although in close proximity, the houses on the hillside were randomly arranged and not oriented toward one another. Limerick and Hardscrabble presented at least a semblance of order: the houses stood in rows and sat only a few paces apart. The nieghborhoods were small enough to become familiar and large enough and close enough to suggest security.

Although by no means the first local examples of ballon-frame construction, [40] the houses at Limerick and Hardscrabble represented the first large-scale use of frame construction by Quincy. Provincial trends and standards are usually contributing factors in the development of a local architectural tradition, and these houses were typical of the low-cost company housing built up and down the Keeweenaw Peninsula. The small houses had "T" shaped plans with anywhere from five to seven rooms, depending on the length of the T-base. The front portion stood two stories high, with a short, steeply pitched roof. The facade sported two ground-floor windows and a centrally located door. The second floor was divided into two rooms with windows on the gable ends. [41]

The interiors were lathed and plastered, while the exterior was clapboarded and devoid of ornamentation. This austerity was characteristic of most of the Quincy housing; low-cost housing did not warrant excessive expenditures on ornamentation. The aesthetics of design were of little concern to the builders, although in the process they created a stark aestheticism of their own.

The architectural record of the Quincy housing is informative in one sense only. All of the extant examples were planned and built by contracted individuals for unknown occupants. There is very little inherent information in the houses about the workers themselves. Although a cultural artifact, the houses are communicative in the sense that they demonstrate what living conditions were deemed adequate by the company.

After 1865, when the first construction boom ended, the company did little to add to their approximately 203 rental properties. [42] Overall employment decreased during this period, from a high of 654 men in 1865 to a low of 346 men in 1868. By 1870 it had begun to climb again, reaching 487 in 1872, the last year of the company's early period. [43] This drop in employment relieved pressures on the housing situation and afforded the company a respite in its dwelling construction. Overall housing policy did not change.

The middle period of the company's housing history began when A. J. Corey became Mine Superintendent in 1872, ending in 1900. Hancock grew substantially during this period, affording Quincy employees privately-arranged housing in "moderate boarding houses...fully if not more than equal to the needs of the community." [44] Quincy's land-lease policy remained unaltered through 1876. By 1881, however, the company began to issue a more restrictive lease. Instead of 99-year agreements, these new documents were effective for only three years. While the agreement was in effect, the tenant was allowed to erect only a dwelling house and necessary outbuildings. As before, no alcoholic beverages were allowed to be sold on the premises and the tenant agreed to pay all required taxes. Unlike the earlier lease, Quincy retained the right to terminate the agreement at anytime for any reason. Upon termination, the occupant was allowed sixty days to remove himself and his buildings from the premises. If this was not done in the time allowed, the company could claim possession of the premises and the remaining structures. The tenant was not allowed to sell or transfer the lease without the company's approval. [45]

This lease was followed by another five-year lease, which was fashioned after a "ground lease to employees" used by the Calumet and Hecla Mining Company. This lease, which called for an annual ground rent of $5.00, was the best means to dispose the lots in East Quincy, since it would pay better than selling the lots for $50.00 to $75.00 each, and it would give the company "the practical control all the time." [46] It can be reasonably assumed that this lease included the same restrictions as the 1881 form. Both these leases were relatively strict and represented something of a high-risk agreement for the occupant and aspiring homeowner.

Quincy's real estate ventures were indirectly related to housing option one and to its land-lease policy. Although the company had originally owned all the land in Hancock village and had sold some of it periodically over the first 42 years, Quincy did not become involved in speculative real estate development until 1890. In that year the "Quincy Addition to Hancock" was platted out at the eastern end of Hancock, just outside the village limits. [47] The Addition plan, which was revised twice, extended from Front Street above the bridge up to Sansom and included some 13 blocks consisting of 102 lots. Some of Hancock's most promising citizens purchased lots in the Addition, paying close to $2,100.00 for a single lot in 1899. [48]

In 1899 the company platted out the "Quincy Hillside Addition" on the northern boundary of the village, from Quincy Street to present-day White Street. [49] In the surveying and grading of this section, Quincy encountered the problem of settling with land-lease tenants who occupied Shantytown, as this area was originally called. The management offered the occupied lots to the tenants at a $100.00 discount on the established price. The difficulty arose when the tenant's house happened to be sitting in the middle of a new roadway, was not acceptable in size or appearance, or did not sit at right angles with the streets as laid out--all such houses had to be removed. [50] To relocate these people the company proposed to buy their houses and offer them company-built dwellings to purchase or lease. [51] Ten such houses were built in 1900. [52]

At the location there was a scattering of privately-owned houses in 1898, 15 of which made up the major portion of the neighborhood which came to be known as "Sing-Sing." [53]

During this middle period, there were no recorded additions made to the mine location boarding houses and few, if any, changes occurred in the general company rental policy. Several significant and costly officers' houses were built over these 28 years. The most impressive project was the large agent's house built in 1880-1882. [54] A classic example of the Italianate style popular in the mid- to late-nineteenth century, the residence cost $25,199.00 to build and decorate. [55]

Construction began just prior to Mine Superintendent A. J. Corey's death in 1880. His successor, F. G. White, was the first to live in the grand house, followed by S. B. Harris and Charles Lawton. Thomas Mason, Quincy's President, wrote Harris in reference to this house:

> "Now I wish to convey to you a request of my young friend Gardner...that if you find the large agent's house too large, or some room enough to allow him with his little family a part of it, he would like to have it so....In this way we can partly utilize our extravagantly large house--to the extent, at least, of the rent received." [56]

Mason recognized the extravagance and expensive burden that such a house represented. Throughout the last decade of the nineteenth century, a few large houses were built at the mine. In 1899 Captain Whittle's stylish house was erected, [57] and the Annual Report for 1900 mentions the construction of "a commodious dwelling for the Superintendent of our smelting works." [58]

The number of workers' houses at the mine location increased dramatically during this second period. Coinciding with a slight increase in the number of men employed, the company built six double dwellings in 1875 and 13 more family units in 1876. [59] The six double dwellings were located in a neighborhood known as Frenchtown. Prior to 1875, Frenchtown was just a smattering of small log houses situated a quarter of a mile west of the County Road. [60] By 1898, it included approximately 26 houses; the double dwellings constituted the backbone of the neighborhood. [61]

The double-family dwelling, or "duplex," was often built by the mining companies because they were more economical for landlord and tenant. The first known examples on the Quincy property were those built at Frenchtown. These were illustrative of the distinct "single gable with lean-to" house form, commonly called a "saltbox." Although usually associated with early New England vernacular architecture, this form was used repeatedly at Quincy and other mining communities. In New England, the saltbox was a double story, four-room unit which had two additional rooms tacked on the back along the long side. The rear roof extended down to cover these two rooms. Although originating from earlier European antecedents, the steep gable and lean-to roof was well suited for New England's heavy snowfall. This fact alone may have been responsible for the use of the form in the Keeweenaw Peninsula.

When used for double dwellings, like those at Frenchtown, the saltbox was consistent in appearance with those of New England. When the single unit was built separately, the lean-to was often left on the short side of the house rather than on the long side.

The year 1888 marked the beginning of a second building boom which was prompted by the erection of a new stamp mill at Torch Lake. This boom continued until the close of the mid-period in 1900, and was marked by developments at both the mill and mine locations. During the summer of that year, a boarding house, designed for eventual conversion into a blacksmith's, carpenter's, and cooper's shop, was erected at the mill site. [62] Sporadically, over the next ten years, 48 houses were built at the Torch Lake location. [63] The majority of the houses formed a community which came to be known as "Mason," named for Thomas Mason, long-time President of the Quincy Mining Company. Located southwest of the mill site, along the County Road (present-day Route 26), Mason was laid out in three parallel rows. Seven of the earlier more substantial dwellings were built to the north of the plant on a knoll which was dubbed "Bunker Hill." [64] By 1900 there were houses for 55 families and places for more than a score of single men in the boarding house, which had recently been expanded--doubling its former capacity. [65]

The ten-year development of Mason represented a major but necessary expense for Quincy. The situation at the Torch Lake site was basically the same as that which had existed earlier at the mine location. The stamp mill site was underdeveloped and lacked the amenities of life. Quincy formed a small community like that at the mine, complete with workers' and officials' houses.

Those houses built in 1889 on "Bunker Hill" were large and intended for the officers at the mill. Shaped like an "L," all of the houses had entrances on the front gable end. The five types differed in overall size and in the height of the "L" section. The two larger examples had full two-story "Ls," affording a total of nine large rooms to each. The smallest example had only three rooms upstairs.

The classes of dwellings were differentiated by the amount of privacy afforded the occupants by the size and plan. Most of the smaller, less comfortable houses were limited in this regard. The houses on Bunker Hill were all variations of the same plan. The larger houses gained space in the addition of an entry, circulation hall, and stairwell. This additional space allowed people to move through the house without moving through the main rooms. The smaller dwellings lacked this space; people were required to pass through rooms to reach other rooms.

From 1892 to 1900 a variation on this and the earlier type was built at Mason. The "T" shaped houses were identical to those in Limerick and Hardscrabble. But like those at Bunker Hill, the main entry was located on the gable end of the house. The door opened directly into a main room, The stair divided this room and the next. The "L" was two rooms long. Although this type had six rooms, privacy was at a minimum since only two rooms were isolated from the general circulation through the house.

Between 1899 and 1900 Quincy reverted to the older plan which had been built at Limerick and Hardscrabble. The major difference was that the newer houses had a second-story room above the front half of the "L." In profile, the houses were typical telescope houses. Slightly larger than the earlier examples, these had windows on the second-story front and gable ends. Eighteen of this type were built at Mason. [66]

The purchase of the Pewabic Mining Company in 1891 increased Quincy's number of dwellings. In reference to the Pewabic lands, S. B. Harris, Mine Superintendent, wrote:

> "We have made good progress also in repairing or practically rebuilding dozens of dwelling houses on the new location--and there are still several old ram-shackles to reconstruct." [67]

There had been three neighborhoods on the Pewabic lands which had been slightly developed prior to the Quincy purchase. "Newtown" was located east of the Quincy No. 2 Shaft, just at the summit of the hill above Ripley. In 1898 Newtown had 30 dwellings, 18 of which were company-owned. Twelve were private houses built on lease land and were probably in existence when Quincy bought the land. The area known as "Lower Pewabic" was located south of the No. 6 Shaft and east of the No. 2 Shaft. In 1898, it included 31 structures, 8 of which were double family dwellings like those at Frenchtown, only slightly larger. Twenty-seven of the houses were company-owned. The third neighborhood inherited by Quincy was the small quarter-mile frontage on the western side of the County Road. Although 13 structures are shown on the 1898 location map, it cannot be said with confidence which of these were single, double, or multiple family houses, or which were there prior to 1891. [68]

As mining activities expanded into these new possessions, the labor force grew from 607 employees in 1889 to 1,366 in 1900, making additional housing a necessity. [69] In 1899-1900, the company built 36 single-family dwellings at Lower Pewabic. [70] These were identical to the telescope houses built at Mason during the same period. The houses on the Pewabic lands were occupied at the time of the Quincy purchase, and it can be assumed that those men were allowed to remain if their employment was transferred to Quincy. Some Franklin mine employees were living in these houses and they were asked to pay Quincy rent or vacate the premises. [71]

A second cause of the increase in workers from 1889 to 1900 was the acquisition of the Mesnard-Pontiac Companies in 1896. This parcel of land was located on the north side of the Franklin mine. When Quincy purchased the property, it inherited approximately 13 structures randomly arranged on the east side of the County Road. Some of these appear relatively large on the 1898 map and were probably boarding or bunk the same time, it tested their genuine concern for the quality of existence which the housing afforded the average employee, and proved it lacking in many respects.

Charles Lawton claimed that he had "wanted to build a little better class of dwelling than is generally found now in the copper country..." [107] He considered a variety of plans and sent several to New York for W. R. Todd's approval. [108] Lawton and Todd both approached the question of design and plan in a most presumptive manner. In June 1917, Lawton writes in reply to one of Todd's inquiries:

> "The two large closets in one bedroom were purposely designed so that the two heads of the family could each have an individual closet, and think it would work to the great satisfaction of our Cornish mining captains, we know their habits and customs." [109]

This apparent concern with the mens' comfort was not absolute. Lawton had originally intended to build two types of units, one for the mining captains, and a less expensive type for the regular class of employees. Upon selection of a final design he determined that the one type would suffice for both captains and miners, but that it would be best to equip only those twelve intended for the captains' use with full heating and bathroom facilities. [110] At no time does Lawton even suggest the installation of these fixtures in those houses being built for the miners. Economics could have been a determinant but such an explanation is never made. Todd does suggest that the houses be equipped with baths and basins, and that the dwellings be located where they might be easily hooked up when a method of sewage disposal was finally installed. [111]

The management soon learned that their employees were far more advanced in their expectations:

> "Many of our best men--vis-a-vis the shift bosses and hoisting engineers--want the houses fully equipped....The miners are inclined to hang back and want their present homes fixed up. It will take some time to have all the houses occupied..." [112]

Several days later Lawton admitted that most of the men would rather have had all of the modern conveniences and pay extra rent than to take the houses as they stood. [113] Soon thereafter, in 1918, the company installed full services in these houses and at all of the other locations. [114].

Any examination of the company housing and the existence which it afforded the employees is going to be tainted by the essential relativity of such a survey. Quincy's apparently late installation of electricity, heating, and plumbing may have been in reality a generous concession when compared with similar developments at the other Keeweenaw mining communities. The expectations of both men and management played a major role in determining what kind of housing was built; the actions of other companies in the area did more to influence these expectations than did the actions of people in the distant east. It follows that Quincy workers would have used the local norm as a measuring stick, and that the company would have felt more pressure from the provincial rather than the national standards. At the same time it must be kept in mind that company officials were at all times conscious of the national trends in workers' conditions, and that if some major discrepancy existed, they should be held ultimately responsible.

Throughout the active history of the Quincy Mining Company, employees exercised all four housing options at one time or another. Each option varied in popularity during the three basic periods of operation. From the start, though, the management favored the construction and rental of location housing for its married employees, and the use of boarding facilities for single individuals. A variety of conditions affected the company's execution of this policy over the years. Nevertheless, it can be asserted that the policy was successful to the extent at least of supplying a portion of the working force with housing near the site. It is difficult to determine whether this force was rendered more stable, less itinerant, and ultimately more production because of the housing service.

Assessing the company's success in supplying adequate housing is a difficult task, since the total number of houses owned each year is not available. In 1919, however, after the final construction boom of 1917, the company owned 761 houses in Hancock and the mining and smelter areas. There were 123 privately-owned houses in the same general area, presumably built on lease land. [115] This gives a total of 884 houses at the Quincy locations, not including Mason. If we consider that in 1917 the company had boardroom for 200 men, there was a possible total of 1,084 living units supplied or supported by the company in 1919. In that year there were 1,646 men employed by Quincy. If we consider that 200 of these worked at the Stampmill, there were 363 men remaining who were forced to exercise option one and arrange privately for housing in Hancock. This is, of course, an approximation and is by no means a fair assessment of the success of failure of Quincy's housing policy.

QUINCY HOUSING

Footnotes

[1] David S. Coon, "The Quincy Mine," Michigan History Magazine, Vol. XXIV, 1940, p. 96.

[2] History of the Upper Peninsula (Chicago: The Western Historical Company, 1883), pp. 286-287.

[3] Ibid., pp. 252, 287.

[4] QMCo Annual Report for 1862, p. 13.

[5] Horace C. Stevens, The Copper Handbook (Houghton, Michigan: 1900), Vol. 1, 1900, p. 226.

[6] QMCo Lease Agreements, 1863.

[7] William B. Gates, Jr., Michigan Copper and Boston Dollars (Cambridge, Massachusetts: Harvard University Press, 1917), p. 5.

[8] Ibid., pp. 96 and 103. Gates includes a table of population figures for the Copper Country. The table covers 1850-1884 and includes total population figures broken down into percentages of male and foreigners in Table 14, pp. 228-229.

[9] QMCo Time Book, June 1851 - March 1855.

[10] QMCo Journal 1859-1861. The rent record shows a general measure, although actual boards ranged anywhere from $10.00 to $15.00 a month.

[11] QMCo Annual Report for 1862, p. 13.

[12] QMCo Journal 1864-1866, December 1865, p. 599.

[13] QMCo Journal 1859-1861, June 1861.

[14] Ibid.

[15] Index to Day Book, General Accounts, 1852-1856; William H. Pyne, "Quincy Mine: The old Reliable," Michigan History, Vol. 41, 1957, p. 230.

[16] QMCo Annual Reports, 1861-1869.

[17] QMCo Annual Reports for 1861-1900.

[18] Construction accounts suggest that many more humble houses, presumably log, were being built. See QMCo Return of Labor, August 1857 - March 1864.

[19] Map of Quincy Mine Location and Vicinity (Hancock, Michigan: J. L. Harris, 1898). See also HAER Map, 1978.

[20] QMCo Dwelling Repair Lists, 1906-1908.

[21] QMCo Annual Report for 1862, pp. 112-113.

[22] See HAER Map for Property Transferals, 1978.

[23] History of the Upper Peninsula of Michigan, p. 267.

[24] QMCo Annual Reports for 1862, p. 112; 1863, p. 12.

[25] QMCo Annual Report for 1863, p. 5.

[26] Coon, p. 95.

[27] Ibid.

[28] QMCo Miscellaneous Account Book, 1864-1865, pp. 358-360.

[29] QMCo Annual Report for 1864, p. 12.

[30] QMCo Miscellaneous Account Book, 1864-1865, pp. 337-338 and 498.

[31] O. W. Robinson, "Recollections of Civil War Conditions in the Copper Country." Michigan History, Vol. III, No. 4, October 1919, pp. 602-603; Pyne, p. 225. There seems to be some disagreement over how many men joined the Union Army. Robinson says that only 20 to 30 out of an unknown total ever enlisted. Pyne implies that the majority signed, abandoning the Copper Companies, which had paid for their passage. The exact fate of the Swedetown location has not been determined. It is never again mentioned in records, and at no time does it appear on Quincy site maps. There is a chance that the location name was changed soon after the defection of the recruits. This seems improbable, however, since a stream which runs through the location retained the name. Most likely, Swedetown was deserted in favor of housing closer to the mine plant. Disuse led to decay, until in 1887 Mason was seriously considering building a mill on the creek. (Thomas F. Mason to S. B. Harris, May 16, 1887.)

[32] QMCo Annual Report for 1864, p. 5.

Baptist Church and the Finnish Lutheran Church. The upper portion of the Addition was irregular and not really suitable for development. H. Z. Brock, an entrepreneur of sorts, proposed to hydraulically fill the ravine and other ditches with stamp stand in return for a fifty-percent share in the lots made available by his work. The proposition was agreed to and begun in 1905. The arrangements and actual project dragged on for close to ten years, resulting in a quarrel between Quincy and Brock's backers, the Dakota Heights Real Estate Company, over the division of lots remaining for sale. [79] These residential developments had a major effect on the appearance and size of Hancock but failed to open up housing options for Quincy employees.

The company boarding houses were usually chosen by the single employees at the mine and mill plants. During this period, board cards were issued which identified the bearer, his house, and the first date of his tenancy. The arrangement for operating the houses remained the same as before, with the arrangement relinquishing the responsibility to an individual or family. The cost of running the houses was carried by the keeper who collected the board fees through the payroll at the mine office. Board included breakfast, underground lunch, and dinner. [80] The management was at all times concerned with conditions in the houses:

> "While we do not want to get into the boarding house business, it is necessary for us to see that the boarding house is properly run and the men have proper food and attention...We cannot afford to have men leaving on account of boarding house conditions if it is possible to retain them. [81]

It went so far as to suggest that in packing the lunches the keeper should "cater to individual tastes as much as possible."[82]

It is not known how many houses were in operation prior to 1913. But in that year, the year of the strike, the company hired John C. Mann to run four boarding facilities at Pewabic, No. 7 Shaft, No. 6, and No. 8. These housed strike breakers brought in by the company who were charged $5.00 a week for the service. [83] It is believed that at least two of these houses, maybe three, were temporary facilities.

The importation of a great number of foreign men in the second decade of this period necessitated the erection of new boarding facilities and the expansion of the old. Charles Lawton, the Mine Superintendent, advised against the continued enlargement of these houses:

> "I, however, am inclined to advise against it; that is to leave so many men congregated in one place would need deputy sheriffs in control all the time,

> twenty-four hours a day, and will add to the expense of maintaining the boarding house, as there are apt to be more quarrels and gambling occurring among such a large body of men together; and yet as a temporary institution it may be best." [84]

In 1916 a boarding house for 40 to 50 men was built halfway between the Pewabic and Mesnard shafts, and in 1917 the management made plans to alter existing structures so they could have four boarding houses housing 200 men. [85] By 1918 the company was running four boarding houses, including the single stamp mill facility. The temporary nature of this investment is demonstrated by the fact that in 1920 only two boarding houses at the mine were operating and these were shut down in September of that year because the keepers were losing money. [86]

As mentioned earlier, Quincy's housing policy was altered in several respects. The most major change was in regard to officials' housing. Until 1900, all leading Quincy officers received their houses rent free. The rationale for this policy was the same as that which prompted the construction of miners' housing. In 1900 the directors determined that:

> "...there no longer exists a good reason why any officers at the mine should be furnished free with house rent, medical attendance, fuel, light, or other supplies, and labor for family use--this being an old custom that has been continued at the Quincy Mine for some time, when good men were hard to obtain and salaries comparatively small, and that as such condition does not now exist, Houghton County Michigan, where the mine is located, having become populous with large business cities and towns possessing all modern conveniences and luxuries, and the mine officials being all well and amply paid for their services." [87]

It was decided that sixteen officials at the mine, who previously received rent-free houses, would be given an increase in salary to cover the additional cost of rent and repairs. [88] The officials were to be charged five percent of the cost or valuation of their houses. [89] In 1902, the Superintendent of the Smelter was paying $16.00 a month in rent; in 1906, the mining Captain paid #30.00 monthly, while the Doctor paid $18.00. [90] The employee rent rate remained comparatively low. In 1909, Smelter employees paid anywhere from $1.50 to $8.00 monthly. [91] But all of the tenants received a $1.00 increase in 1916 as a charge for the newly installed water system. [92] When Quincy built fifty large houses in 1917, they were determined to charge

$12.00 for those without heating and plumbing, and $15.00 for those with these facilities. Although the men protested, Lawton, who intended these houses for only the best-paid miners, assured W. R. Todd that such houses in Hancock would rent for not less than $20.00 to $25.00. In 1919, there was a slight increase for those dwellings which rented for very little. [93] These increases were due to normal inflationary trends and to the heavy expenditures being made on maintenance of the house.

From 1882 to 1924 repeated references to dwelling repairs appear in the company Annual Reports. [94] When W. R. Todd expressed concern over repair costs, Lawton explained that while the tenants supplied, say, decorative wallpaper, the company man would put it up. In the case of painting and any other maintenance jobs, the company supplied the materials and labor for the work. [95]

The number of houses on the location increased during this final period. In 1907-1908, there were seven double and seven single-family dwellings built in the Mesnard neighborhood. [96] These dwellings were arranged in rows parallel to the County Road, giving Mesnard an appearance similar to Limerick, although it was not as uniform in house type. Unlike the telescope houses of 1899-1900, these new structures, both double and single versions, were of the saltbox type discussed earlier in reference to Frenchtown.

In 1908, Quincy purchased the surface and mineral rights of the Franklin Mining Company: "The ownership of the two half-mile square of surface at the mine location also embraces many dwellings and other buildings." [97] This included a series of dwellings along the County Road across from the Franklin No. 4 and No. 5 Shafts, and a collection of no less than 50 houses known as "Backstreet," which sat one-fifth of a mile off the road. Like Hardscrabble, Backstreet was laid out in regular rows orientated to Franklin's property line; in this case the westernmost line which had divided Pewabic and Franklin lands. Maps reveal that most of the houses were of uniform size, with both single- and double-family examples. [98] It is not possible to determine exactly when the houses at Franklin were built, although those of Backstreet probably stood prior to 1890.

In 1917 Mine Superintendent Charles Lawton initiated the third building boom of the company's history. In March of that year he recommended the construction of eight houses for the mine shaft captains and engineers. This, he concluded, would open up eight of the nicer dwellings for the shift captains, and so on down the line. He also recommended the erection of 50 new dwellings for the miners, "so that we can have a steadier crew about the mine, fewer transient men, and more of the better families." [99] Lawton was still convinced that company housing was a benefit which would both attract and retain employees; this was the rationale which prompted the construction of most of the older neighborhoods at the various mine locations. He attributed the need for the new housing to the "continually congested living conditions in Hancock and to the growing desire of employees to dwell at the mining locations and be nearer their work."[100] In the end Lawton built only 50 houses, five of which were doubles.

When determining where to place the new houses, Lawton chose not to create a new neighborhood but clustered the houses between the older communities. Three houses were built in Frenchtown, one in Sing Sing, three behind the assay office, seven at a new location east of Hardscrabble, two in Limerick, eleven at Mesnard, and twenty four at Lower Pewabic. [101]

The houses were built from Sears, Roebuck and Company drawings and were exceptionally large, measuring 28'x28'. They were of frame construction with a full masonry basement. Consisting of four bedrooms and a bath on the second floor, they also had an entry hall and stair which allowed a degree of privacy never before found in the regular class of employee housing. The double house form was merely two singles joined by a party wall. Quincy built only five of these even though the difference in construction costs between one double and two singles meant a savings of $388.00. Lawton asserted that most men preferred the single houses over the double. [102]

During this same period, 1917-1918, the company built six additional saltbox houses at the millsite. According to Lawton, half the mill employees were forced to live in Hubbel, and Quincy was continuously losing these men to the Calumet and Hecla plant because they were unable to supply housing at the Mason plant. [103]

As with the two previous housing booms, this last one coincided with an increase in the number of men employeed: from 1,373 men in 1914 to 1,734 in 1917. Employment fell off from 1917 until the mine closed in 1931, [104] during which time no additional houses were built.

In the first quarter of the twentieth century Quincy was faced with the added expense of modernizing company houses. In 1906 only eight houses, all rented to officials, had electric lights and the Quincy boarding house had electric lights. It was not until 1917 that the management began installing outlets in all the newer and older houses. [105]

In 1916 a new waterworks system was installed. [106] This system only supplied running water and did not include proper sewer drainage or disposal. Most of the older houses still lacked bathroom facilities in 1918. The fifty new dwellings constructed in 1917 were illustrative of Quincy's desire to improve and update the company-owned housing. At houses. [72] The erection of 12 telescope houses in 1899-1900 was prompted by the want of housing near the No. 8 Shaft site, being worked at Mesnard. [73]

This construction boom, which occurred at the end of Quincy's middle period, was prompted by a new, large labor force. This enlarged force was the result of expanded operations on Pewabic and Masnard lands and by the new milling work which required a separate community altogether. It is interesting that Quincy continued to erect single-family units rather than boarding houses. Keeping in mind that the company probably inherited several boarding facilities when it purchased Pewabic and Mesnard, their construction policy was illustrative of the company's preference for hiring married instead of single men. The land-lease option was never stressed or recommended for Quincy employees. Mill workers never excerised this option as Mason and even though Quincy was involved with the real estate additions to Hancock, few employees could afford to take advantage of the opportunity. On the acquired properties, there were many privately-owned houses which were added to the list of lease-land occupants, but there were just as many inherited company-owned houses added to the rentroll. By 1898, the company owned over 300 houses, enough to warrant the adoption of a numbered house identification system for keeping track of tenants and repairs. Prior to this, the record was kept by the name of the current occupant. [74]

The final thirty years of Quincy's operation was marked by changes in general policy and an increase in construction of company-owned houses and boarding facilities. Private housing in Hancock probably increased, although this cannot be documented. There is no evidence that land-lease agreements changed. Quincy continued to invest in real estate, beginning with the Lake Shore Addition in 1901, which was an area in West Hancock located between the cemeteries and the Lake. A good portion of it was deeded to the Sisters of St. Joseph Hospital in 1901. [75] This development was followed by the platting and dedication of South Quincy in 1903. South Quincy was situated between Ripley and East Hancock. [76] It was the intended neighborhood for the Quincy Smelter, which sat just below it on the banks of Portage Lake. The Quincy Smelter was built in 1898; in that year Quincy owned three houses near the plant. At the time South Quincy was planned, there were four dwellings standing, all owned by the company. One of these was later occupied by the Superintendent of the Smelter, although this was not the house primarily mentioned as having been built for this officer in 1900. [77]

In 1903, the Second Hillside Addition was surveyed and platted. This rested just above the original Hillside Addition of 1900. [78] The Quincy Addition to Hancock was resurveyed in 1901 to 1905, with the advent of a scheme to improve the lots thereon. The Addition was boardered on the west by a ravine which cut up between the Portage Lake

[33] Ibid., pp. 12-13.

[34] See HAER Map (Housing), 1978.

[35] See HAER Map (1864 Silverspare Map), 1978.

[36] Map of Quincy Location, 1898.

[37] See HAER Map (1864), 1978.

[38] Map of Quincy Location, 1898.

[39] The origins of the housing location names can only be surmised. At no time does an explanation appear in the written record, although the names are used early on, always set off by quotation marks. "Side Hill," "South Quincy," "Pewabic," "Backstreet," and "Newtown" are self explanatory; others like "Frenchtown," "Limerick," "Swedetown" appear to be so. "Hard-scrabble" refers to a type of earth; "Sing Sing" remains a mystery.

[40] Reference to frame house appears in QMCo Annual Report of 1862.

[41] See HAER File Photo, 1978.

[42] QMCo Annual Reports for 1866-1872.

[43] QMCo Annual Reports for 1865; 1868; 1870; 1872.

[44] History of the Upper Peninsula of Michigan, p. 291.

[45] QMCo Lease Agreements 1881-1885.

[46] S. B. Harris to W. R. Todd, August 8, 1896.

[47] QMCo Annual Report for 1890, p. 12.

[48] C. D. Hanchette to S. B. Harris, August 9, 1899.

[49] Plat of Quincy addition to Hancock, 1890. Plat of Hillside Addition, 1900.

[50] W. R. Todd to C. D. Hanchette, October 24, 1899.

[51] Dumstun and Hanchette to W. R. Todd, July 23, 1900.

[52] QMCo Annual Report for 1900, p. 12.

[53] Map of the Quincy Location, 1898. See HAER Map, 1978.

[54] QMCo Annual Report for 1880, p. 3.

[55] QMCo Journals 1879-1882, pp. 303, 413; 1882-1887, p. 32.

[56] Thomas Mason to S. B. Harris, December 4, 1883.

[57] QMCo Annual Report for 1890, p. 12; 1897, p. 12, 1899, p. 13.

[58] QMCo Annual Report for 1900, p. 13.

[59] QMCo Annual Report for 1875, p. 14; 1876, pp. 21-22.

[60] See HAER Map (1864), 1978.

[61] Map of the Quincy Location, 1898.

[62] QMCo Annual Report for 1888, pp. 12-13.

[63] QMCo Annual Report for 1889, p. 11; 1890, p. 12; 1892, p. 15; 1893, p. 15; 1895, pp. 14-15; 1897, p. 12; 1899, p. 13; 1900, p. 12.

[64] See HAER Map (mill), 1978.

[65] QMCo Annual Report for 1898, p. 12.

[66] QMCo Annual Reports for 1899, p. 13; 1900, p. 12.

[67] S. B. Harris to W. R. Todd, November 4, 1891.

[68] Map of Quincy Location, 1898.

[69] (Charlie Hyde figures.)

[70] QMCo Annual Report for 1899, p. 13; 1900, p. 12.

[71] S. B. Harris to T. Mason, April 17, 1891.

[72] Map of Quincy location, 1898. See HAER Map, 1978.

[73] QMCo Annual Report for 1899, p. 13; 1900, p. 12.

[74] QMCo Rent Roll, 1880; QMCo Dwelling Repair Lists, 1906-1920.

[75] Plat of Quincy Lake Shore Addition, 1901.

[76] Plat of South Quincy, 1903.

[77] Map of Quincy Location, 1898.

[78] Plat of the Second Hillside Addition, 1903.

[79] Harry Baer to W. R. Todd, December 1, 1914.

[80] John C. Mann to Charles L. Lawton, November 21, 1913.

[81] W. R. Todd to Charles L. Lawton, May 4, 1917.

[82] C. Lawton to John C. Mann, December 2, 1913.

[83] John C. Mann to Charles L. Lawton, November 21, 1913.

[84] Charles Lawton to W. R. Todd, April 13, 1917.

[85] QMCo Annual Report for 1916, p. 15; C. Lawton to W. R. Todd, June 18, 1917.

[86] C. Lawton to W. R. Todd, September 27, 1920.

[87] QMCo Director's Minutes, New York, January 15, 1900.

[88] Ibid.

[89] Ibid.

[90] Lease for A. D. Jones, 1902; QMCo Dwelling Repair Lists, 1906-1920.

[91] F. McLain to H. M. Tompkins, circa 1909.

[92] W. R. Todd to C. Lawton, December 7, 1915.

[93] C. Lawton to W. R. Todd, July 28, 1917; C. Lawton to R. Todd, June 10, 1918; QMCo Employee Notice, July 19, 1919.

[94] QMCo Annual Reports, 1882-1924.

[95] C. Lawton to W. R. Todd, September 22, 1917; Todd to C. Lawton, April 1, 1918.

[96] QMCo Annual Report for 1907, p. 13; 1908, p. 12.

[97] QMCo Annual Report for 1908, p. 16.

[98] Map of Quincy Location, 1898. See HAER Map, 1978.

[99] C. Lawton to W. R. Todd, April 2, 1917.

[100] QMCo Annual Report for 1917, pp. 16-17.

[101] See HAER Map, 1978.

[102] C. Lawton to W. R. Todd, June 18, 1917; C. Lawton to W. R. Todd, July 21, 1917.

[103] C. Lawton to W. R. Todd, August 11, 1917.

[104] (Charlie Hyde figures.)

[105] Dwellings with Electric Lights, December 20, 1906; W. R. Todd to C. Lawton, July 25, 1917.

[106] QMCo Annual Report for 1916, p. 15.

[107] C. Lawton to W. R. Todd, July 17, 1917.

[108] C. Lawton to W. R. Todd, March 23, 1917.

[109] C. Lawton to W. R. Todd, June 13, 1917.

[110] C. Lawton to W. R. Todd, July 17, 1917; C. Lawton to W. R. Todd, July 25, 1917.

[111] W. R. Todd to C. Lawton, July 25, 1917.

[112] C. Lawton to W. R. Todd, June 10, 1918.

[113] C. Lawton to W. R. Todd, June 13, 1918.

[114] QMCo Annual Report for 1918, p. 18.

[115] List of QMCo Dwellings Houses and Privately-Owned Houses on Quincy Location as Re-numbered and Revised, September 1, 1919.

QUINCY MEDICAL SERVICE

The hiring of a physician for the care and treatment of the mining labor force was an eighteenth century Cornish tradition brought to the region by the earliest immigrant miners. The institution was adopted by the Keeweenaw mining companies during their first years of operation, and came to be regarded by both management and men as a mandatory service. Functioning as a type of "industrial health insurance," employees paid a required medical fee directly from their earned wages: fifty cents for single men, one dollar for married men. It was not clear how extensive this service was originally, but it was soon expanded to cover all the medical needs of employees and their families.[1]

At the Quincy Mining Company the system functioned in the manner described from the early 1850s up until 1931. Although it may have fallen short of expectations, the medical department was at all times a serious concern of the company; so much so that as early as 1862 Quincy built a hospital facility for the mine,[2] and in later years ran a mine pharmacy, employing a fully licensed pharmacist.[3] The management was always conscientious in its choice of a physician. In all, ten chief doctors worked for the Quincy mine from the early 1850s until 1931.[4] Prior to 1863 the company had hired a physician in conjunction with other mining companies, perhaps Pewabic and Franklin, and each paid a share of the total cost.[5] These doctors worked at the Quincy location under such an agreement. The first physician, Dr. Clark, came from Boston in the early fifties.[6] Successive doctors were either experienced mine physicians or seasoned general practitioners possessing fine surgical ability.[7]

In a related department, W. R. Todd was justifiably concerned when he learned in 1915 that "Little Eddie", the acting apothecary, was not a "graduate." He warned that Quincy could not afford the change that the young man might make a mistake in the administration of drugs.[8] This demonstrated concern with the experience, professionalism, and ability of prospective chief doctors and pharmacists was not exercised in the company's selection of assistant physicians. When the need presented itself, anywhere from one to three assistants were hired, many of whom had just finished their medical training. This was the case when Quincy's last doctor, Dr. A. F. Fischer, first came to the Hill in 1890, just out of the University of Michigan.[9]

The position held by the chief physician reflected the company's confidence and expectations. He was considered a mine official, and for this reason he received rent free housing. He was also one of the highest paid employees: in 1863 the chief physician earned $133.33 a month,[10] by 1927 he was receiving $390.00 monthly, close to $4,700.00 a year. As such the physician was subject to the conditions of employment dictated by the management.

> "....all must serve the company diligently and to the best of their ability, and during the time in which they shall be engaged, they shall not engage in any other service, for themselves, or for another party, nor in any trade, profession, business or calling other than the employment for which they are engaged, except by special permission given by the Superintendent or Agent, nor are any officials permitted to absent themselves from the company's business and employment in which they are engaged, except by like permission.[11]

The restriction on extermal employment was particularly stressed for the position of chief physician. It was believed that the resident doctor should be stationed at the mine at all times.[12] Even when he was inaccessible due to a personal illness, the management insisted that another doctor be obtained to fill the temporary vacancy.[13] Several applicants for the position were not hired because they had intended to continue in their private practice while working "full-time" for Quincy.[14] This regulation was not always easily enforced. A most notable example was Dr. Neal MacDonald, company physician from 1901-1912, who managed to retain some of his private patients.[15] When A. F. Fischer was hired to replace Dr. MacDonald, W. R. Todd, Quincy's president, insisted that he be informed of this regulation and that he abide by it after his appointment.[16] When Fischer was honored five years later by two outside institutions requesting his part-time services, the management insisted that he refuse the offers and concentrate solely on his work at the mine.[17]

Within the confines of the medical department, the chief physician was given a free hand, as long as he remained answerable to the management. Although the assistant physicians were considered company employees, ultimately hired and fired by the management alone, the company respected discipline and tried to support the authority of the chief physician in the department. More than once confrontations flared up between chief and assistant; in at least one case this resulted in the discharge of the underling.[18]

The practice followed by the medical department over the first six decades were curative rather than defensive medicine. Besides the treatment of the mining related injuries, the doctor carried on a full-time consultation clinic. The description of this clinic was given in 1890 by A. F. Fischer:

> "My friend Dr. Ford that evening gave me a short introduction to my new surroundings, pointed out the calomel bottle, the box of salts, the can of Castor oil, the jug of Downer's Standard Cough Medicine, and the demijohn of liniment, further the drawer containing tooth forcips (sic)

> (this introduced me to the fact that I was to be dentist as well as doctor) and another in which was a bone saw, an old army tourniquet and an assortment of knives with tortoise shell handles that closed like a razor.....
>
> The Dispensary consisted of two room, one quite large, the greater portion of which not taken up by the coal stove was devoted to a waiting room and operating arena. The other portion was supplied with a counter back of which there were shelves filled with bottles of medicien. The patients as called would step forward to the counter, relate their ailments before the doctor and the audience and receive advice and medicine according to the merits of the recital.[19]

When Fischer inherited the department in 1912 he initiated the first steps in defensive medicine. In 1913 he formed instructional classes in First Aid, which upon completion qualified the graduate for a Quincy Mining Company First Aid Certificate. In the same year, the U. S. Bureau of Mines sent representatives to Quincy to demonstrate mining rescue work, firefighting, and first aid.[20] Supposedly the men took such an enthusiastic interest in the subject that by December of 1914, Charles Lawton was able to report that in a year's time not one simple fracture was compounded while moving the injured individual from underground to the hospital.[21]

It is not clear what prompted Fischer's "Safety First Movement." Whether it was his own idea or his response to a national trend in mining operations, it permeated the men's lives and their work. One major result of the program was administering physical examinations to all job applicants prior to employment: "This was done in order to make certain that the perspective employee not only has the essential qualifications of understanding the work for which he may be hired, but that he also is physically able to take care of himself, as well as of his fellow workmen, and not be a menace to them in any way.[22] Applicants were rejected if they demonstrated any type of ailment or weaknesses, such as irregular heartbeat, hernia, high blood pressure, etc.[23]

Once the general health policy took this turn the company made additional tangible efforts towards improving the care and well being of their employees. In October 1918, during an influenza epidemic, the management took an active part in circulating information and trying to contain the illness by closing schools and restricting the use of the bathhouse facilities.[24] In January 1919, Fischer expanded the medical service to include the following: a mother's advice clinic, baby care and feeding clinic, pre-maternity clinic, special clinics for diseases of women and men, follow up medical call, health advice department, Special Electronic Treatment, x-ray service, and a visiting nurse.[25] To cover the costs of these services, the company raised the medical fee by 25¢.[26]

From the beginning of the medical service in the early 1850s, the company was never parsomonious when it came to supplies or facilities, although by today's standards the arrangements seemed premature. Prior to 1864 the doctor rented his office from the mine, or mines, for which he was employed.[27] In 1862-65, Quincy built a three story, 35 room hospital.[28] From at least 1874 on, the company maintained a dispensary, which was located behind the doctor's residence a few hundred feet south of the mine office.[29] In that year, A. J. Corey described the facilities as "one of the best and largest....on the lake."[30] The Dispensary, previously described by A. F. Fischer, was a two story frame structure, with three rooms upstairs and three downstairs. Later in 1905, and again in 1915, additions were made to enlarge the office space and create three apartments, probably intended for assistant physicians. Previously, the assistant physician had inhabited a single room on the ground floor.

Over time, the medical care at Quincy was not consistently superior and at points, it was poor and inadequate. Not intending to appear contradictory, it must be understood that the manggement was at all times sincere in their desire to supply adequate, efficient, and capable medical treatment. Proper medical care was viewed as an essential and it was their responsibility to arrange for it. But intentions are not always manifested as realities and at times the medical service fell short of both management and employee's expectations.

The fault did not lie with the company or with the facilities. It usually sprang from the internal organization of the medical department and its members. The disputes between chief and assistant physicians and the problem of prohibiting private practices sprang from a lack of discipline. The New York office had trouble enforcing rules and regulations, while the local management was either not interested or was tool involved with running operations to worry about it.

At time, the difficulty could not have been foreseen or prevented, Such was the case with Dr. Downer, who A. F. Fischer described as "a prince of a man as well as a capable physician. He was the ideal mine doctor......"[32] Downer worked at Quincy from 1884 until 1897. Near the end of this period, he became addicting to some drug, most certainly opium or morphine,[33] and in fact tried to nurse the doctor back to health until: "In spite of all that has been done for him he got on a 'toot' again and drugged himself into imbelicity so I notified him to get out -"[34]

Such an occurrence cannot be used as evidence against the Quincy medical service. There is evidence, however, that at times the medical department did not function to the satisfaction of the employees. A letter in reference to A. F. Fischer was sent to W. R. Todd in 1917:

> During your visit here will you please investigate conditions in the medical service of the mine. We are charged for a service that we do not get, and feel that there is no redress. When there is a serious illness in the omes we are forced to employ other doctors, pay for the medicine which is no small item in times like the present. If you would learn the truth of these statements you may ask any employee except the Supts. We feel that this is an injustice that you as president of the company should know, and we have every confidence that you will make matters right.
>
> We believe our head doctor would make a first class preacher he should lecture less and do more for the people who need the services of a good doctor, the preaching part we can provide for ourselves......"[35]

Although this must be taken with a grain of salt since it was signed only "Your Employees," this letter raises questions about the actualities of the medical service. Such a rancourous complaint does not appear in any other sources from that period.

QUINCY MEDICAL SERVICE

Footnotes

1 Gates, William B., Jr., Michigan Copper and Boston Dollars (Cambridge, Mass.: Harvard University Press, 1951), p. 104.

2 The Hospital construction account appears in QMCo Ledgers for 1862 through 185.

3 QMCo employment cards, 1916-1927.

4 The ten major doctors who worked at Quincy were as follows:

1. Dr. Clark
2. Dr. Fuller
3. Dr. Robbins - 1859-1863
4. Dr. Carpenter - 1863-1865
5. Dr. Flannery - 1865-1870
6. Dr. Pleus ?
7. Dr. Shepard - 1870-1884
8. Dr. Downer - 1884-1897
9. Dr. N. MacDonald - 1897(1901?)-1912
10. Dr. A. F. Fischer - 1912-1932

5 QMCo Journal 1861-63, January 1861, p. 15. Entry in Hospital account for 1861 shows Quincy paying proportion of Doctor salary.

6 A. F. Fishcer, "Medical Reminiscense," Michigan History, p. 31.

7 T. Mason to S. B. Harris, January 21, 1884; H. B. Daniels to S. B. Harris, October 16, 1896; W. R. Todd to S. B. Harris, June 17, 1901; W. R. Todd to C. Lawton, August 2, 1912.

8 W. R. Todd to C. Lawton, June 8, 1915.

9 Fishcer, p. 27.

10 QMCo Journal 1861-63, June 1863, p. 681; QMCo Employment Cards 1916-1927. The assistant physicians received considerably less. In 1863 the assistant received $50.00 monthly and in 1927 he received $175.00 per month.

11 W. R. Todd to J. B. Turner, June 17, 1901.

12 W. R. Todd to Charles Lawton, December 13, 1910.

13 W. R. Todd to Charles Lawton, December 17, 1917.

14 W. R. Todd to Charles Lawton, August 2, 1912.

15 W. R. Todd to Charles Lawton, December 13, 1910

16 W. R. Todd to Charles Lawton, August 2, 1912

17 W. R. Todd to Charles Lawton, June 4, 1917; C. Lawton to W. R. Todd, July 14, 1917; W. R. Todd to C. Lawton, July 19, 1917.

18 W. R. Todd to C. Lawton, September 21, 1910. C. Lawton to W. R. Todd, December 8, 1910; W. R. Todd to C. Lawton, August 2, 1912.

19 Fischer, pp. 29-30.

20 QMCo Annual Report for 1913, p. 20.

21 QMCo Annual Report for 1914, p. 19.

22 Ibid., pp. 19-20.

23 QMCo Monthly Medical Reports, 1925-1932

24 C. Lawton to W. R. Todd, October 24, 1918

25 QMCo Notice, January 1, 1919

26 C. Lawton to W. R. Todd, December 6, 1918.

27 QMCo Journal 1861-63, January 1861, p. 15.

28 QMCo Ledgers 1862-1865

29 See HAER map: Housing and Community Structures at the Quincy Location and Vicinity, 1978.

30 A. J. Corey to Meport Burrough Brothers, April 22, 1974.

31 See photograph - HAER file.

32 Fischer, p. 31.

33 QMCo Invoice Book 1870-72, Order to A. J. Scott. Drugs, Medicines, Chemical paints. October 31, 1871. This is just one specific order for Opium and Morphine; others appear throughout the QMCo Invoice Books.

34 S. B. Harris to T. F. Mason, June 26, 1897.

35 "Your Employees" to W. R. Todd, May 17, 1917. Another suggestion of internal disorder appears in an earlier letter, May 13, 1913, from Dr. N. MacDonald, the former chief physician at Quincy. In it he requests the return of his surgical instruments, stating that "I simply want what is left of the wreck." (Dr. N. MacDonald to C. Lawton, May 13, 1913.)

QUINCY SCHOOL

The company ownership of most of the land in Quincy Township established it as the major taxpayer in that municipality.[1] As such, the company's support of the township school district was not just voluntary patronage, it was a legal responsibility. In essence, the township was not providing taxpayers with educational facilities; the company was providing an additional service for its employees. In such public activities, it was virtually impossible to differentiate between township and company affairs. Because of its power, Quincy openly dictated the management of the Public School District No. 1 from 1867, when the district was organized, through 1928.[2]

The company's attentiveness to school concerns was genuine and transcended their minimum legal obligation as a taxpayer. They wanted to furnish the township residents, their employees, with adequate facilities while retaining control over the school district. The end was realized in part by the assured election of company officials to District offices. From 1867-1928, mine superintendents, doctors, captains, clerks, and even master mechanics served as District Assessor, Moderator, or Director.[3] During the last decade of the nineteenth century into the twentieth, these officials received yearly $25.00, $25.00, and $50.00 respectively for their services.[4] The Assessor functioned as treasurer and bookkeeper of the District, and the Director served as the leading administrative official. The role of District Moderator is difficult to ascertain but it can be safely assumed that he chaired school board meetings.[5] With Quincy officials serving in these positions, the company maintained a strict relationship with school affairs.

The basis of this relationship was understood outside Quincy Township. When the company built the stamp mill housing in Mason, Osceola Township, it was required to erect a school house to accommodate the influx of additional children. Although Quincy did not govern Osceola Township as it did Quincy Township, the school at Mason was Quincy's responsibility. Originally, the company requested that a separate district be established for the Mason school so they might supervise their "own" children. The request was withdrawn because the company was allowed to manage the district even though it remained under the legal authority of Osceola Township.[7] This arrangement worked so well that, in 1917, when the company feared the loss of its control in Quincy Township, W. R. Todd sugggested that Charles Lawton, mine superintendent, look into the specifics of the Mason situation for an example of how schools should be run.[8]

The company exercised a certain amount of district control by retaining ownership of the school houses. The districts rented and maintained the buildings.[9] From the first year of District No. 1's organization, there was a frame school house on the Quincy location with a 150 student capacity.[10] This was located a few hundred feet off of the county road (Route 41), just east of Frenchtown.[11] The original building must have been relatively large and after it was expanded in 1875-77, it had a full capacity of 300 students.[12] This enlarged facility measured 96'x26'. Rectangular in plan, it had a central stair and four classrooms, two up and two down. Quincy made another addition to this building in 1895, extending two new rooms and a separate out-house wing, which was connected to the main facility[13] by a long partitioned (male/female) hallway. These improvements were warranted when enrollment increased over the years from 175 students in 1867, to 270 in 1917.[14] The Mason school house, built in 1892, was 26'x30' and seated 25 to 30 children.[15]

In 1917, the management deemed it necessary to contract a small school for the children of the Lake Annie District who were not attending because they lacked transportation to and from the existing school. W. R. Todd was particularly concerned with the truancy problem, but was assured by Charles Lawton that "there is a law that can be readily enforced, but when we go to enforce it you will find that the school board has been negligent in not providing a school building."[16] Lawton calculated that transportation for the children would cost more than the construction and maintenance of a new, one room school. As was customary, the building would be rented to the District thereby eclipsing the formal election which might have "allowed the renters to dictate the actions of the company."

The company's dictation extended into the classrooms only to the extent that district (company) officers selected and hired the teachers. Most, if not all, of the teachers hired were legally certified to teach.[18] For the first decade of operation, the District managed with two instructors; this increased to 3 in 1877, and eventually reached a total of 9 teachers in 1912. J. G. Johnston taught at the Quincy School for 30 years and retired in 1922 at the age of 71.[20]

The teachers were free to plan their curriculum and drew up courses of study based on state requirements and basic textbooks. The school was graded from 1868 and a high school department appeared on the record in 1884. Latin, trigonometry, and algebra were three of the more complex subjects taught as early as 1876.[22]

The school near Frenchtown was not the only school on the location. The Pewabic and Frankling mining companies built schools prior to Quincy's purchase of their lands and operations. Quincy exercised no control over these schools until 1896 (Pewabic) and 1908 (Franklin). Even then, these school districts belonged to Franklin Township, a factor which did not necessarily inhibit the company's exercise of control but certainly divorced their affairs from those of School District No. 1, Quincy Township.[23]

QUINCY SCHOOL

Footnotes

1 QMCo Tax Assessor's Ledgers. 1867-1904.

2 Annual Reports of School District No. 1, of the Township of Quincy, County of Houghton, to the school inspectors for the years 1867-1880, 1904-1928. Although this was probably the case up through 1931, when the mine closed, the known record only extends to 1928.

3 Ibid.

4 School District No. 1, Quincy Township. Assessor's Cash Book 1967-1904. School District No. 1, Quincy Township, Director's Books 1907-1912.

5 In one particular instance, the Moderator sent home a report of misconduct to a student's father. It is assumed that this was an exceptional case, warranting the involvement of the District Moderator. See: Moderator, Quincy School District to Joseph Giles, October 29, 1910.

6 QMCo Annual Report for 1892, p. 15.

7 S. B. Harris to W. C. Watson, Osceola mine, August 31, 1892; W. C. Watson to S. B. Harris, September 2, 1892; S. B. Harris to W. C. Watson, September 3, 1892. The specifics of the arrangement were such that Quincy selected the teacher, built and owned the school house, and supplied the coal. The school was supported by township taxes.

8 W. R. Todd to C. Lawton, July 23, 1917.

9 Annual Reports of School District No. 1, of the Towship of Quincy, County of Houghton, to the School Inspectors for the years 1867-1880, 1904-1928. S. B. Harris to W. C. Watson, August 31, 1892.

10 Annual Report of School District No. 1, . . . for the year 1867.

11 See HAER Map ____, 1978.

12 Annual Reports of School District No. 1, . . . for the years 1876-78. The exact physical size of the school prior to 1875 cannot be determined from existing sources.

Footnotes, cont'd.

13 QMCo Annual Report for 1895, pp. 14-15.

14 School enrollment never reached the maximum 1895 school house capacity of 350 students. It peaked in 1897-98 at 315 students. The school additions were built when enrollment increased to the extent that it became necessary to relieve the unmanageably large classes. Annual Report for the School District No. 1 . . . for 1867-1880, 1904-1928. Annual Summaries as it appear in Courses of Study and Record Books, School District No. 1 . . ., 1884-1911.

15 S. B. Harris to W. R. Todd, November 4, 1892.

16 C. Lawton to W. R. Todd, July 23, 1917. The Lake Annie District was located out beyond Swede Town Creek. Most of the truant children were from the farms of the area. See HAER Map _____, 1978.

17 C. Lawton to W. R. Todd, July 19, 1917.

18 Annual Reports of School District No. 1 . . . . for the years 1877-1880, 1904-1928.

19 Ibid; School District No. 1. Assessor's Cash Book 1892-1907; School District No. 1 Director's Books 1907-1912. There was at all times one male teacher in the School District. On the average, he received a salary double that which was received by the highest paid female instructor. Through the 1870s, the wage for the senior male faculty member was $100.00 a month; the female members received $50.00 a month.

20 J. G. Johnston to Trustees of Quincy School District, January 28, 1922.

21 The Annual Reports for School District No. 1., Quincy Township . . . . for 1867-1880, 1904-1928, and the Course of Study and Record Books, School District No. 1...1884-1911, give a relatively complete picture of the texts used and the courses taught in the various departments of the school.

22 Ibid.

Footnotes, cont'd.

23 It can be assumed that Quincy took an equal interest in the affairs of the schools after it acquired control over their buildings and property. The Pewabic School was located in the Lower Pewabic, behind the No. 2 shaft and hoist. (See HAER Map ____, 1978) Photographs reveal that it was similar to the Quincy School in size, design, and construction. The Franklin School was located on the west side of the county road (Route 41) just north of the Franklin housing. The original school was a large frame building like the Quincy school; in 1917 it was transformed into a boarding house. The construction date of the new school is not known although it was certainly built between 1917 and 1928. It was a large brick two-story building, with a decorative bell tower on top. The operational histories of these schools is know known, the records not being available.

THE QUINCY LOCATION STORE

During the earliest years of Quincy's operation, when the Keeweenaw Peninsula was still relatively isolated and the winter mail delivery was brought in by dog sled,[1] the adequate supply of provisions was as necessary to the maintenance of a labor force as the adequate supply of housing or medical care. In 1851, Ransom Sheldon, the miner superintendent, opened the first general supply store on the Quincy location.[2] Although affiliated with the company, Sheldon ran the store as a private commercial venture and continued to operate it through the early 1860s after he had left the employ of the company.[3] For the first sixteen years the needs of the company employees were met by private storekeepers like Sheldon.

Quincy chose not to get involved in the purveyance of food and supplies during the early years. The demand was probably not sufficiently great to warrant investment in a business which would have been an additional responsibility and financial complication. Until 1861 when the company began dividend payments, it had no surplus capital to expend; most of it having been reinvested in the mining operation.[4] The Civil War and Quincy's newfound financial stability affected a change in this state of affairs. A general increase in wages for most Quincy employees during the first years of the war was not enough to offset the high cost of goods and services.[5] Either by popular demand or on their own initiative, Quincy resolved to run a mine store which would supply workers with provisions at wholesale prices.[6] In 1863-64, the company built a store on the west side of the County Road (Route 41), just north of the mining office.[7] During the fall of 1863, the company purchased enough stock to get their employees through the winter.[8]

In the short run, the store allowed the workers to live more cheaply; in the long run it made them "less fluctuating and more reliable."[9] This latter effect was the result of the company using the store as a method of labor control. The system was slow to evolve and it is not certain whether the management recognized the possible implications when they opened the store. Nevertheless, its organization allowed the company to exercise a certain amount of economic control over their employees. The store sales were recorded daily and each purchase was entered in a general ledger under the customer's individual account. The bill was settled by deducting the debt from the salary of the employee.[10] This could financially cripple a worker if he happened to overextend himself and ran into debt. If this happened, he had to work off his debt, like a sharecropper.

This accounting system was not intentionally designed to sink the unsuspecting employee into debt. The store was established for the benefit of both the employees and the company. By cushioning the men from fluctuating prices and the rising cost of living, the company was able to regulate the cost of labor.[11] The billing system was initiated to protect the company and to insure payment, just as the mandatory medical fee was deducted from the employee's pay to insure the general support of that service. It was usually the employee who first allowed himself to overextend on credit, and there was no rule that required the men to buy at the company store. The system was viewed favorably by most parties and was adopted by most of the companies in the region.

Quincy sold the store to Seth D. North in September 1866.[12] It lost money while running the store and apparently was anxious for North to take it off its hands. The company placed no restrictions on North, nor did it require the men to do business there.[13] All bills collected through the office were charged 2% for this service; North never received any favoritism in this regard even though he held the major portion of the Quincy trade.[14]

North was at all times concerned with selling his goods at the lowest possible prices. According to A. J. Corey, the mine superintendent in 1872, North kept the Houghton-Hancock merchants in check, holding prices 10 to 20% lower than would have been expected. In 1872, North paid $450.00 a year in store rent, plus house rent, plus 20¢ per ton for dockage and storage.

With North and other area merchants drawing payments directly from the Quincy payroll, an employee in debt was obliged to negotiate with the company and the storekeeper. Such was the case in 1884 when an employee by the name of John O'Neil discovered that he could not draw his pay directly from the mine office because he was indebted to North's store. He was forced to go to Seth North when he needed cash. Finally, he tried to arrangement a payment schedule to take care of the debt but North still refused to allow him to collect his full pay directly. The Quincy management did nothing to alleviate the problem and refused to take action without North's approval.[15] In 1900, W. R. Todd, Quincy's President, expressed his doubt and disapproval of the system. He recommended that North not be allowed to collect the bills of the "young and single men" through the office, and that such a liberty only be allowed with the bills of married men who had given North permission to do so.[16] In 1914, Todd insisted that the practice be discontinued altogether.[17]

North moved his business out of the original store in 1896 so that the building might be cleared to make way for the new mining office.[18] He relocated just up the stree in a larger, stone, store building. This structure, the land it was on, and North's house were all leased to him for five years beginning in 1900.[19] The lease required a payment of 2-1/2 percent on his gross sales on a quarterly basis. A similar agreement existed between Quincy and James H. Seagar and Company, the Franklin location store, after Quincy purchased the Franklin Mining Company in 1908.[20] Seagar and Company appear to have been doing business at Franklin for several years prior to Quincy's acquisition. They afforded North some stiff competition since they were located just several hundred feet north on the County Road (Route 41). Their store was as accessible to the limerick and hardscrabble residents as was North's.[21]

THE QUINCY LOCATION STORE

Footnotes

1 O. W. Robinson, "Recollection of Civil War Conditions in Copper Country," Michigan History Magazine, Vol. III, No. 4, October 1919, p. 603.

2 W. H. Pyne, "Quincy Mine: The Old Reliable;" Michigan History Magazine, Vol. 41, 1957, p. 220.

3 QMCo Ledger, 1862.

4 Robinson, p. 601.

5 Ibid.

6 Ibid.

7 QMCo Journal Misc. Journal, 1864-65, pp. 440, 486. See HAER Map: Housing and Community Structures at Quincy Location and Vicinity. 1978.

8 Robinson, p. 601.

9 QMCo Annual Report for 1863.

10 QMCo Merchandise Blotter and Store Accounts 1863-66.

11 A. J. Corey to Horatio Bigelow Esq. February 4, 1874

12 QMCo Annual Report for 1867, p. 15.

13 A. J. Corey to W. R. Todd, December 12, 1872.

14 A. J. Corey to W. R. Todd, December 29, 1873.

15 John O'Neal to QMCo, August 9, 1889.

16 S. B. Harris to W. R. Todd, January 12, 1900.

17 W. R. Todd to C. Lawton, May 5, 1914.

Footnotes, cont'd.

[18] T. F. Mason to S. B. Harris, May 16, 1895.

[19] Lease to George North for store purposes, May 17, 1900.

[20] C. Lawton to W. R. Todd, October 1, 1917.

[21] See HAER map: Housing and Community Structures. Quincy Mine Location and Vicinity; 1978.

MINING OFFICE

During active history, the company had at least two main mining offices. It is not known where the administrative department was housed prior to 1864, but in that year, the year of Quincy's first construction boom, work was begun on what was called the "New Office."[1] It was situated on the west side of the county road just south of the existing office.[2] The building was a small two-story frame structure which cost the company $6,000.00 to construct.[3] It had two front entrances; one probably serving as a separate entrance to the second floor.[4]

This office served the company's purposes for thirty years. In the spring of 1895, S. B. Harris, the mine superintendent, and Tho. Mason began discussing plans for a new office.[5] The site of the old office was still considered favorable and convenient, so early on, Mason suggested that it be removed prior to the designing and placement of the new building.[6] They eventually elected to build the new office on the plot of ground just north of the old, allowing the 1864 structure to remain standing, and in use, until the new office was completed. George North's old store, which was located just north from the old office had to be removed to make room for the new building.[7] Construction began in the spring of 1896 and continued through the summer, the second coat of interior plaster and the "modern" plumbing was installed in September of that year.[8] In the Annual Report for 1896, Harris mentioned the project and described the office as "very convenient and serviceable . . . ."[9] The building was finally completed in 1897.

The new office building measured 56 feet wide x 44'6" deep and stood 44' high. It afforded the company approximately 2400 square feet of floor space per floor. Constructed entirely of local, red, rough cut sandstone, the walls were 1'6" thick. The full hipped roof was finished in slate and two 18' tall stone chimneys flanked the central, decorative, iron crest piece. Visually symmetrical, the facade was divided into three bays. The central bay jutted a foot beyond the face of the building. On the first floor, this bay was built out to form the entry porch, also constructed of sandstone. The six support columns, roof, cornice and upper railing of the porch were made of wood, as were the engaged columns which flanked the second floor windows, and the main, dentilated cornice. Above the central bay was an 11' tall pediment pierced by an arched window which lit the interior attic with natural light.

The two side bays of the main facade had two sets of windows, one set of double hung full paned windows on the second floor, and one set of large arched windows on the first floor. These arched windows were topped by 3 feet tall sandstone keystones which carried the vertical line of the lower window's center jamb to the second floor window. The south side of the building had four sets of windows arranged similarly, while the north side fenestration appear irregular because of a large stairwell window which lit the landing. The rear elevation was almost identical to the front, except for the window and door treatment of the central bay.

The interior plan of the office was simple in conception. Off of a small foyer were located the superintendent's office to the right, and the head clerk's office to the left. A straight hall ran from the foyer to the rear of the building, ending at a small office which gave access to the rear exit and porch. To the right and left of this office were two additional offices; the library was in the office on the right. Off to the right of the small central hall were the stairs and the bathroom. All of the offices were connecting, except the Superintendents, which allowed circulation without entering the hall or entry area.

The second floor plan was similar. The stair opened on a general circulation area. Two rooms opened immediately to the left and right, coincident with the Superintendent's office and the library respectively on the first floor. Three more offices, at least two of which were used as the company engineer's office, were located over the first floor entry hall, head clerk's office, and the assistant clerk's office.

The interior of the office was handsomely finished. The wood work was exposed, lightly stained oak, right down to the "Primo-Perfecto" oak toilet seats in the bathroom.[10] Most of the offices had fireplaces with beige tiled hearths, oak mantels, and mirrored over-mantels. The office doors were filled with frosted and etched glass; the stairwell light was made up of two 40"x60" and 40"x36" pieces of diamond-patterned etched glass.

Ceilings reached a lofty height of 11'2" on the second floor and 12' on the first, with baseboards standing 12" to 14" high. Doors on the second floor measured 3' x 7', but the entire doorway, including mouldings and transom windows measured 4'2" x 9'3". On the first floor, the entire doorway measured 4' 5-1/2 x 10-1/2'.

MINING OFFICE

Footnotes

1 QMCo Annual Report for 1864, p. 12.

2 See HAER Map ___, 1864

3 QMCo Annual Report for 1864, p. 12; for 1865, p. 14.

4 The only surviving visual records of this office are two photographs taken in 1896, just prior to the removal of the office from its site.

5 Thomas Mason to S. B. Harris, May 16, 1895.

6 Thomas Mason to S. B. Harris, August 23, 1895.

7 Thomas Mason to S. B. Harris, May 16, 1895.

8 S. B. Harris to W. R. Todd, September 4, 1986.

9 QMCo Annual Report for 1896, p. 13.

10 Specifications for QMCo office plumbing, Robert C. Walsh, 1895.

QUINCY FARM

Grounded on the same basis as that which necessitated the company store, the Quincy farm furnished the company and its employees with staples such as hay, oats, potatoes, and turnips.[1] As with store supplied provisions, farm produce of this sort, especially feed for strock and draft animals, was related to the survival of the labor force and the success of the mining endeavor. It can be assumed that during the first decade of operation the company was capable of obtaining these provisions in the quantity required from local sources. Reference to direct company involvement in farming does not appear until 1861. Perhaps by that time the requirements of the company were great enough to warrant investment in a farming endeavor.

In 1861, $1,052.54 was spent on clearing land, and fence and seed supplies.[2] The farm produced little or no fresh or immediately marketable foodstuffs such as vegetables or fruit; most of these items were grown in individual gardens. Potatoes were grown on the farm periodically and 250 bushels were harvested in 1919.[3] But employees retained the option to lease potato plots and garden lots at three locations, Frenchtown, Backstreet and Klondike "farms", for a ground rent of five dollars apiece.[4]

From 1862-1867, the farm was leased to O. K. Patterson & Co., the teamsters at the mine. In 1862, Patterson paid $600.00 rent on the farm, by 1867, he was paying $1000.00 annually. During that period, Patterson's men cleared a minimum of 250 acres of land.[5] It was fitting that Patterson was in charge of the farming operations since he possessed both the manpower and animals to work the farm; in a sense he was investing in his primary occupation of teaming, since most of the feed went to his draft animals.

The leasing of the farm was not a continuous practice. In 1898, S. B. Harris, mine superintendent, informed a David Sonotat that they had no intention of leasing the farm that year.[6] The location of the farm is not known, although in 1917 part was situated behind the FRanklin School.[7] Physical improvements on the farm fell to Quincy regardless of whom it was leased to; this included construction, repair, and fence maintenance.[8]

QUINCY FARM

Footnotes

1 QMCo Annual Report for 1867, p. 16.

2 QMCo Annual Report for 1861, p. 12.

3 QMCo Annual Report for 1919, p. 17.

4 QMCo Miscellaneous Journal 1864-65, p. 305; QMCo Employee Notices, 1919-1922.

5 QMCo Account Journals, 1862-67.

6 S. B. Harris to David Sonotat, February 19, 1866.

7 A single surviving miscellaneous map showing numbered land divisions, some of which were labeled as the Quincy farm, 1914.

8 QMCo Account Journals 1862-67.

CLUB HOUSE

Those services initiated during the first twenty years of the company's history, such as housing, medical care, and the company store, were closely linked with the immediate survival and sustenance of the labor force. In later years the management became involved in supplying the workers with the more extraneous creature comforts that would improve the overall quality of life experienced by the employees and their families. Such a spirit of benevolence, condensed with other factors, prompted the erection of the Quincy Mining Company Club House in 1916.

The Club House, as built, was essentially a community bathhouse:

> "The ground floor is fitted with facilities for bathing, dressing rooms, steel lockers, bathtubs and showers,, with hot and cold running water. It is steam heated and electrically lighted, with suitable separate entrances and accommodations for both men and women. The second floor consists of an assembly or lecture room and reading rooms . . . ."[1]

In 1918, the reading room was converted into the company library. This change accordingly "popularized the library and rendered it more useful to the employees and their families."[2]

Apparently, William R. Todd, Quincy's President, and his son, W. Parsons Todd, were the first to propose that a Club House be built.[3] Their reasons for doing so were never clearly expressed in their correspondence with Charles Lawton. Nevertheless, they are easily inferred from the correspondence. The precedent established by the Calumet and Hecla Mining Company influenced the decision to build a Club House at the Quincy location. Calument and Hecla's original bathhouse had been housed in the basement of the company housing. The expansion of the library and the demands placed on the bathhouse required that a new, separate facility be built. This was done in 1913 at a cost of $50,000.00. The facility included tubs, showers, and a 26'x40' swimming pool.[4] The Quincy management tended to regard the relatively comprehensive company services and labor related activities at Calumet and Hecla as exemplary. During the same period, Quincy was losing men to the Calumet and Hecla stamp mill because, unlike Quincy, that company was capable of supplying adequate housing at the mill site.[5] In most instances, Quincy felt obliged to follow suit if they wanted to remain on equal footing in the bid for laborers. Todd specifically suggested that the Calumet and Hecla bathouse be used as a model for Quincy's Club House.[6] He suggested also that Lawton look into what sort of similar things had been done at the iron mines of the Upper Peninsula.[7]

The company's new-found benevolence, which was prompted partially by the example of others, was also solicited by the short term benefits it would afford the management. The erection of a bathhouse bought time for the company by allowing them to postpone the installation of a location-wide bathing and sewage disposal system. In 1916, the year that the Club House was contructed, a new, complete water works system was installed; this supplied all the housing locations with running water. But it was not until 1918, two years after the erection of the clubhouse, that the company finally installed toilet and bathing facilities in the individual homes, only after the laborers demanded it.[8] The Club House bathing facilities was used, and possibly conceived of, as an alternative to the individual bathroom. Although this is never formally recognized as a cause, or result, of the Club House being built, the chronology of events was such that it is not unrealistic to assume Todd and Lawton understood the hidden implication of the Club House plan.

Todd's approach to the design and management of the Club House was particularly conservative. He insisted that the Club House facilities be confined to the bathhouse and reading rooms:

> "Your several letters regarding 'Club House' received, in all of which is suggested the idea of a place for "amusement," which I think very objectionable on the location, and such a thing will in my opinion affect good discipline and interfere with work. What I advise is only a "Bath House" for men and women, under proper supervision and control, with a reading room connected. This matter of amusement is entirely personal and a thing or business I do not believe the company would be justified in encouraging, it promises only trouble without any good results."[9]

Early in the planning, he rejected a design which included a billard room and bowling alleys.[10] He also vetoed the inclusion of a swimming pool, a feature present in the Calumet and Hecla Bath House.[11] Although the Club House was open to women, they were not allowed to use the main stairway to the second floor, and the intermingling of men and women in the entry hall was to be strictly controlled by the caretaker of the facility. The caretaker was expected to be a teetotaler, a consistent church-goer, and a strict disciplinarian who would not allow card playing in the establishment.[12]

The resulting two-story structure was located across from the No. 2 shaft house. The Club House entirely was a red brick with stone foundation, string course, and keystones. It sported a dentilated cornice, and was capped with a flat roof. Overall, it measured 91'6" x 30'4". The facade was divided into nine window bays; the center portion, the vestibule, extended 4 feet from the main facade, with the porch extending another 8 feet beyond that. The rear of the main structure was attached to the caretaker's apartment.

The bathouse was located on the first floor. Upon entering the central foyer, the men's area was to the left and the women's area was to the right. The men's facilities included six showers, three baths and four toilets. The shower stalls and bathing units were semi-private, but the men undressed in a large public locker area. The women's facilities had three showers, six baths, and four toilets. All of these showers and bathing units were designed with private changing rooms, although a large public locker room was available. Only 23 individuals could use the facilities at one time, even though there was locker space for 30 people. As mentioned earlier, the second floor held a lecture hall, reading room, and bosses room, which was reserved for the exclusive use of shift bosses and other miner officials.

Todd's ideas regarding the design were followed down to the smallest detail. It is difficult to say whether he was actually liberal in his concessions (the woodwork and furniture were mahogany),[13] or extremely parsimonious. When compared with Calumet and Hecla, the latter seems more likely. This is especially true when considering the smallness of the facilities relative to the several hundred men in the employ of the company at the time.[14] It is not known how many people used the Club House on a regular basis. The bathouse was open to all Quincy employees and their families every day except Sunday.[15] Even so, two years after the opening of the Club House, Todd advised that the second floor reading room be continuously stocked with the most current periodicals in order to induce more men to use the second floor, and then, ultimately, draw their attention to the bathing facilities on the first floor.[16]

By 1920, most families had sewage, water, and bathing services in their houses and there was really no need for a community bathhouse.[17] The library functioned until 1930,[18] but is is not known exactly how often employees used it. By 1925 part of the Club House was serving as a boarding house for newly arrived mine recruits.[19] No doubt the Club House would have received more patronage if Todd had agreed to more entertaining uses for it.

CLUB HOUSE

Footnotes

1 QMCo Annual Report for 1916, p. 16.

2 QMCo Annual Report for 1918, p. 18. The company library had a salaried librarian from 1918 to 1930 who received $35.00 to $45.00 a month for her services (QMCo Employment Records). The management's serious concern with the library was demonstrated when in 1918 William Rogers Todd recommended an expenditure of six hundred dollars for new library books, a suggestion which was more or less vetoed by Charles Lawton because of the low (23 cents a pound) price of copper in that year. (Charles Lawton to W. R. Todd, October 28, 1918).

3 W. R. Todd to Charles Lawton, November 22, 1915.

4 Arthur W. Thurner, Calumet Copper and People (Hancock, Michigan: Arthur W. Thurner, 1975), p. 53.

5 Charles Lawton to W. R. Todd, August 11, 1917.

6 W. R. Todd to Charles Lawton, December 22, 1915.

7 W. R. Todd to Charles Lawton, November 30, 1915.

8 Charles Lawton to W. R. Todd, June 10, 1918; Charles Lawton to W. R. Todd, June 13, 1918. QMCo Annual Reports for 1918; for 1919.

9 W. R. Todd to Charles Lawton, December 9, 1915.

10 W. R. Todd to Charles Lawton, November 30, 1915.

11 W. R. Todd to Charles Lawton, December 22, 1915.

12 W. R. Todd to Charles Lawton, March 17, 1916. Charles Lawton to W. R. Todd, April 7, 1917.

13 Charles Lawton to W. R. Todd, March 30, 1917.

Footnotes, cont'd.

14 Total employment figures for 1916, 1917, and 1918 respectively were: 1646, 1734, and 1691 men. In all three years, less than a quarter of these men were miners. Miners had bathing facilities at the Change Houses, and it is unlikely that they would have found a need for the bathhouse. Nevertheless, the remaining employees, and all of their families, would have had to use the facilities at one time or another. (QMCo Annual Report for 1916, 1917, 1918.)

15 QMCo Club House; Bathouse Rules and Regulations (Hancock, Michigan: QMCo, 1917).

16 W. R. Todd to Charles Lawton, August 30, 1918.

17 See footnote #8.

18 There was a librarian in the employ of Quincy up until 1913. See footnote #2.

19 A. J. Dahl to QMCo., November 30, 1925.

MISCELLANEOUS SERVICES, PHILANTHROPIC ACTIVITIES, AND SOCIAL CONTROL

Besides the principal company services, Quincy also performed small miscellaneous acts of assistance for its employees and the community. Most of these services originated in Quincy's sense of place and role in the lives of the people in the district. The sole source of income for many and an influential force for all, the company extended itself beyond what they considered to be the necessary services, and entered the world of public philanthropy and patronage. Less related to the maintenance of a stable labor force, these small favors reflected an interest in improving the lives of its neighbors by adding a little pleasure, ease, and moral support.

Many of these small acts were reserved for employees only. The sale and delivery of coal was only available for Quincy men and their families. The coal was priced the same as, or slightly cheaper than that sold by retail suppliers. Delivery was free and assured, a factor which afforded quite a saving of time and money, especially during the winter months.[1] Of services intended for the entertainment of the employees, the company library and the Quincy band was the most obvious. The band was a late addition to the community. It was regarded seriously when it was in operation. In 1903, the company went so far as to hire a man especially as the bandleader and then reserve a place for him in the assay office so that he might work fulltime and increase his income.

The Quincy "Christmas Tree" was the most indulgent gesture made by the company. It appears to have been initiated late in the company's history. As it was handled in the 1920s and 30s, the company handed out "Christmas Tree" tickets to all of the children on the location and at the mill. Each ticket entitled the child to a box of candy and a gift from under the Christmas tree.[2] These celebrations usually occurred at two or three separate places on the location, and included a visit with Santa and caroling. In 1927, the company ordered 600 pounds of candy for the occasion.[3]

The company policy in regard to injured men and widows was by no means consistent or clearly defined. It is assumed that permanently injured men were taken care of or settled with in some way. It is known that widows were allowed to remain at the location in their houses rent free.[4] It seems that in later years specific cases were treated separately or given special consideration. For example, in 1916, even though he warned against establishing a precedent, Todd approved the donation of $100.00 to Enrico Toddvicci for the purchase of an artificial leg; Toddvicci had lost his in a mine accident.[5] In cases where a miner without relatives died, the company usually covered the cost of the burial.[6]

Quincy's importing of foreign labor created social difficulties for both men and the management. The company made every effort to aid the immigrants. For example, all written information was printed in the several different languages spoken at the mine. In special cases, the management made a concerted effort to help individuals in their attempts to bring the remainder of their family over.[7] In one instance, the company averted the deportation of a German miner who had entered the country illegally.[8] Although such favors helped retain good employees, the loss of one or two men would not have crippled their operations.

The company's relationship with the non-Quincy community was marked by conscious altruism. Quincy supported most public spirited endeavors by either making land available or by giving small monetary donations. In 1897, it sold a lot to the Village of Hancock for the prupose of erecting a new Fire Hall. Later, in 1924, Quincy sent the Hancock Fire Department a $100.00 check in thanks for their services at a Quincy Hall call.[9] The Finnish Seminary of Hancock bought a lot from Quincy in 1897,[10] and in 1901 the company deeded a Lake Shore Addition lot in West Hancock to the Sisters of St. Joseph Hospital.[11] Located to the immediate north of the hospital lot were the Catholic and Protestant cemetaries. These cemetaries were situated on Quincy owned property and had been since the earliest days. Although the company believed the maintenance of these properties was the responsibility of the village, W. R. Todd's sense of decency moved Quincy to erect a fence around the cemetaries in 1919 after they had received a notice from the board of health.[12]

Such activities cannot actually be called charitable. In most cases, the land was not donated, it was sold or leased at a fair market value. But these transactions were illustrative of Quincy's willingness to cooperate with the citizens of Hancock in their attempts to improve their village.

As early as 1862, the company deeded land to the Congregational Church for construction of a church building.[13] In 1865, they deeded land to Bishop Frederic Baraga for a one dollar consideration.[14] In later years, land was donated for the Portage Lake Baptist Church, the Pewabic Methodist Church, the Catholic Church on Quincy Hill, the Finnish Lutheran, and the Jewish Synagogue.[15] The support of these religious organizations was a consistent policy: "As we have always thought it desirable to encourage the erection of churches, in fact, I think every church located in Hancock was given free the ground on which it stands, . . ."[16]

Quincy officials always spoke of improving the moral character of its men. Support of churches was viewed as an induct means to this end:

> "We believe that Rev. Father Kronemay prove a desirable resident and may be of some value to us in cases of misunderstanding with our men, and if he can do as he writes 'train the minds and hearts in the fear of God and in respect for authority, law and order' he should prove a good man to keep among us."[17]

This concern was more or less synonymous with the company's attempts at social control. Social control meant a variety of things to the management, although it did not necessarily imply law enforcement. If the company spent time and money on services meant to attract and maintain a stable labor force, it follows that any interference in the stability of that force would be viewed negatively. They made every effort to squelch possible disruptions and to instill in the men a work ethic which would serve their purposes. Most controls were indirectly preventative such as the patronage of churches, and the hiring of married men. More obvious was the company's forbiddance of the sale of alcholic beverages on company owned land. Even leases issued to ground tenants carried this restriction.[18]

Quincy did not really experience any major difficulties which could be viewed as extraordinary or insurmountable. A constant source of disruption was the eruptive conflicts which often occurred between ethnic factions. This was particularly true in the earliest period, 1848-1872, when the labor force was primarily Cornish, Irish, German, and French Canadian.[19] But such conflicts continued to occur in later years when a large number of Swedes, Finns, Croatians, Russians, and Italians were brought to the location.[20] At times, the management discriminated against certain groups because they felt them to be particularly disruptive:

> "The Irish being the most disturbing element I suggest that in any changes that are being made it may be well to keep in mind that it is not best to increase in that nationality."[21]

This ever-present social disturbance was aggravated by another more prevalent difficulty. That which interrupted work and incited brawls was, of course, the great amount of drinking which was indulged in by miner, mechanic, and clerk alike. The problem illicited a most uncompromising response from company officials.

In the first two to three decades of operation, when most men lived together in boarding houses, drinking and brawling was a major problem. In 1864, after a general increase in wages, the drinking reached such a point that men either showed up at work drunk or not at all. Ronson Sheldon formed a vigilante committee in order to persevere public safety[23] and the company hired a watchman to patrol the streets[24] thirty-nine years later.

In 1903, J. L. Harris received the following letter:

> "I thought you would not allow no one to sell liquor on the Quincy property. There are three Italian saloons in Newtown. I would like if you would see to it at once, especially the log house it is opened night and morning, men fighting and losing their work."[25]

Though this state of affairs continued, even on the location, it never reached the proportions that it had in 1864.

Statewide prohibition in 1918 was again welcomed by the company and seen as an effective solution to the problem.

> "It may drive a number of men out of the district, the Italians in particular, as we often hear of their remarking that they would leave, etc. However, I feel that the absence of liquor will work to a great advantage in our mining operations, and will actually reduce costs, as the class of men that we would retain would work more steadily."[26]

Miscellaneous Services, Philanthropic Activites, and Social Control

Footnotes

[1] C. Lawton to W. R. Todd, June 27, 1917; QMCo Employee Notice, September 12, 1919.

QMCo Invoice Book, Bood Order, to Portage Lake Mining Gazette from Quincy Township Library. October 29, 1879; QMCo Report for 1918, p. 18.

[2] J. L. Harris to Tom Symington, Novemebr 27, 1903. Symington received $55.00 per month for his work in the assay office, and $10.00 monthlyfor his work with the band.

[3] QMCo "Christmas Tree" Journal, 1920-1934.

[4] W. R. Todd to C. Lawton, March 11, 1915. QMCo Repair Record 1902-1920.

[5] W. R. Todd to C. Lawton, January 25, 1916.

[6] S. B. Harris to Mrs. Catherine Garland, December 1, 1894.

[7] In one particular case, an Austrian minor wrote his wife telling her that there was work in the area for cooks and that she might come and be employed as such. The woman wrote QMCo inquiring about these possible positions. QMCo replied, with a favorable report on her husband's work and his word, immigration laws did not permit them to offer a job prior to immigration. (Anna Osenerek to General Manager, QMCo, February 7, 1919).

[8] F. J. McLain to W. P. Todd, April 15, 1925.

[9] S. B. Harris to T. F. Mason, January 7, 1898. This lot was on Quincy Street and measured 75x20. The village paid $2500.00 for it; C. Lawton to Hancock City Fire Department, July 18, 1924.

[10] S. B. Harris to Thomas Mason, December 9, 1897; Andrew Johnson to Thomas F. Mason, July 21, 1897.

[11] W. R. Todd to S. B. Harris, June 11, 1901.

[12] W. R. Todd to C. Lawton, August 10, 1914. Todd insisted upon taking this action because livestock was being allowed to wander through the cemetaries.

Footnotes, cont'd.

[13] C. Lawton to W. R. Todd, March 13, 1917.

[14] Deed of land to Bishop Frederick Baraga (The Snoe Shoe Priest), September 6, 1865.

[15] Description of Baptist Church lot and deed, September 28, 1891; S. B. Harris to Thomas F. Mason, April 8, 1893; W. R. Todd to C. Lawton, June 3, 1913; W. R. Todd to C. Lawton, October 12, 1908.

[16] W. R. Todd to C. Lawton, October 12, 1908.

[17] W. R. Todd to C. Lawton, June 6, 1913.

[18] QMCo Land Lease Agreements, 1861-1896.

[19] William H. Pyne, "Quincy Mine: The Old Reliable," Michigan History Magazine, Vol. 41, 1957, p. 228. Pynes describes various sundry battles which occurred during this early period.

[20] W. R. Todd to C. Lawton, June 18, 1917.

[21] T. F. Mason to S. B. Harris, April 20, 1887.

[22] Pyne, p. 224.

[23] QMCo Journal, 1864-66, February 1864, p. 26.

[24] Anonymous letter to J. L. Harris, c. October 17, 1903.

[25] C. Lawton to W. R. Todd, December 3, 1917.

"Quincy Mining Company: Stamp Mills & Milling Technologies, c. 1860-1931"

by

Charles F. O'Connell, Jr.

I

INTRODUCTION

Few mining companies are able to profitably dispose of their product without first subjecting the mineral to some sort of a milling operation. This was certainly true of most of the copper mines in the Lake Superior region, the few short-lived mass maines being the obvious exception. The mass mines obtained their product from large, naturally existing bodies of relatively pure mineral called "masses" and discarded much copper bearing rock because the mineral was not sufficiently concentrated. When the masses ran out the mines either closed down or began to work the rock that had been considered worthless. The mineral in this rock had to be mechanically or chemically concentrated before it could be profitably marketed. The chemical concentration and purification took place at the smelter. The mechanical concentration necessary to prepare the mineral for smelting was done at the mill.

The mass mining companies were the first commercial enterprises to appear in the Michigan copper district. They tended to begin operations almost as soon as they had clear title to some land, in most cases without extensive exploration or planning. The mass mines usually flourished briefly and often faded as quickly as they had appeared. The readily accessible masses had been mined and the cost of operations increased as the shafts were sunk deeper into the suspected veins. The "mass mentality" seems to have pervaded the management of the Quincy Mining Company for about the first six years of its corporate existence. Incorporated on March 30, 1848, under a special charter issued by the State of Michigan, the company spent its first five years searching for the elusive masses of copper in the sparse Quincy vein, but without noticeable success. Quincy's stockholders became so discouraged, they authorized the termination of all mining operations in 1854.[1]

The fortunes of the Quincy Mining Company revived in 1856 when the neighboring Pewabic Mining Company discovered the rich vein of copper that was given its name. The Quincy Company discovered that the Pewabic vein crossed Quincy-owned property, so preparations were made to exploit the vein. The Pewabic Company had already discovered that the vein contained some masses of copper but also significant amounts of the mineral in smaller bodies that could not properly be called masses but were valuable nonetheless. At some point the Quincy management decided that the company's offers would be best served if the company moved to exploit both the masses and the smaller bodies of copper. To this end, the company decided to build a stamp mill, probably some time in 1958. The wisdom of this decision is seen when one considers that Quincy was able to economically work the Pewabic vein continuously from 1860 to 1931 and then again from 1937 to 1945, although the operations of the latter period are beyond the scope of this report.[2]

No one in the Quincy management questioned the need for a mill. The product of the miner averaged about 4% copper. Since the cost of smelting was based on the gross weight of the mineral smelted and not on the net weight of the final product, rock that was 96% useless could not be profitably used. The company needed to boost the mineral content of its rock by eliminating waste rock. The job of the mill was to stamp, sort, and classify the copper-bearing rock. The end result of this process was a relatively clean ore concentrate, free of waste rock and ready for chemical purification in a smelter. In the Lake Superior "Copper Country," the mining companies tried a number of different systems to achieve the desired result.

The Quincy Mining Company, working the Pewabic vein, obtained its copper from amygdaloid, one type of copper-bearing rock. Amygdaloid is a volcanic rock with cavities (vesicles) that have been filled with secondary deposits of another mineral, in this case, native copper. Native copper is naturally existing pure copper, that is, copper that is not contaminated by other minerals. The name amygdaloid is derived from the Greek word for almond - the copper-bearing cavities are frequently almond-shaped. The amygdaloid matrix, the rock that surrounds the copper bodies, is relatively soft and more brittle than the copper. Therefore, amygdaloid is readily broken by a number of variably sized and powered stamps.[3]

Most of the Lake copper companies constructed mills that, from outward appearances at least, followed similar patterns. The location of these mills was partially determined by a number of requirements common to most milling operations: an abundant supply of water, a convenient connection to the mine, and an area to dispose of the waste rock. The stamping and sorting operations generated certain design criteria applicable to most milling complexes and gave these sites a general external similarity. This similarity is most readily demonstrated by examining a hypothetical stamp mill complex in the Michigan copper district.

A mill needed vast quantities of water as the medium to carry the rock through the milling process and to effect the hydraulic separation essential to the washing stages. The need for an abundant source of water was one determinant of the location of the mill. It also affected the form of the mill building and necessitated a number of auxiliary structures at the mill site.

Stamp mills were invariably located near a large body of water, usually either a lake or a swiftly moving river. For example, the shores of Portage and Torch lakes in the Keeneenaw Peninsula were lined with a number of stamp mills: Quincy, Pewabic, Frankling, Tamarack, Osceola, and Calumet and Hecla all built sizeable facilities on the shores of these two lakes. Most mills had stepped or sloping roof lines and they were built on the side of a hill if possible. The slope of the mill building site generated the flow of water.

The water had to be moved from its source to the milling process. If the mill was not situated near an adequate natural flow of water, the company would have to install a pump, build a pump house and include some form of steam generating plant in or attached to the pump house. These boilers also provided power to run the stamps, although some of the earliest stamp mills relied on a water wheel to provide power. The boiler plant burned either coal or wood, so a storage facility for these fuels was usually constructed in close proximity to the boiler furnaces.

The actual stamping and concentration process were different at each mill. The Quincy system will be discussed in detail below. However, in all cases, the process generated a vast quantity of waste rock called tailings. These tailings were theoretically worthless (although they invariably contained copper that had not been caught at some point during separations) and had to be disposed of. The disposal system usually consisted of wooden or iron conduits called launders that carried the tailings, still suspended in water, to a dumping place. In most cases, the wastes were dumped in the same body of water that served as the source of water for the mill, thus completing a circuit of sorts. These waste sands inevitably built over time and in some instances came to pose a serious threat to navigation channels. If this happened and a governmental body decided to take action, the mill would be forced to close down or perhaps relocate. Some of theses areas of waste sands became so substantial that many maining companies used the land created by their accumulated waste as storage areas for fuel or other mine supplies.

In most respects, the mills the Quincy Mining Company opened in 1860, 1890, and 1900 were externally similar to their "Copper Country" contemporaries and exhibited all of the features common to similar mills in the area. However, the Portage Lake mill was decidedly atypical in many important aspects, especially in the field of stamping technology.[4]

II

THE PORTAGE LAKE MILL, 1859-1892

The Quincy Portage Lake Mill was located on the north shore of Portage Lake and was connected to the mine by means of a wooden tramway. The company built a bank of boilers and a high capacity pump, although these were attached to the mill building itself and not enclosed in a separate structure. Tailings were dumped in Portage Lake, and this practice eventually led to the problem that forced Quincy to relocate its mill in 1888.

Between 1856 and 1860, the company performed extensive exploratory and preparatory work on its portion of the Pewabic vein and on its surface mining properties. During that period the company spent $292,727.38 "for real estate and permanent improvements on same - including dwelling houses . . ., machinery, steam engines . . ., docks, warehouses and other buildings and roads.[5] Among the facilities constructed at that time were the stamp mill and railroad.

The Quincy Mining Company did not begin construction of its Portage Lake mill until 1858, but it is likely the company had some milling equipment available, if not in operation, as early as 1852. In that year Robert B. Davidson, president of the company, informed Christoper C. Douglass, the company's agent in Michigan, that he was "authorized to procure a few head of stamps, as many as may be required.[6] There is no evidence to suggest that Douglass bought the stamps, but since the company did produce some mineral throughout the early 1850's it is probable that he did. Any stamps he purchased would have been Cornish model gravity stamps. The descendants of these first few head of gravity stamps were to play a major role in the history of Quincy milling operations from 1860 to 1892.

The exact date of the construction of the first Quincy mill is not known, although available evidence suggests that work on the foundation was begun in late 1858. By September 1859, extensive work was underway on both the mill and the tramway that connected the mill to the mine site.[7] The mill was located approximately 3,000 feet southwest of the mine, at the base of Quincy Hill in the village of Hancock. The tramway ran straight up the side of the hill until it reached the summit, where it made a sharp, flat right hand turn toward a row of shaft houses. [The HAER drawing of a Quincy Mining Company map of c. 1865 shows the facilities of a stamp mill complex and its relation to the rest of the mine facilities. It also shows the route of the tramroad.]

The mill the Quincy Mining Company opened in 1860 contained 64 head of Cornish model gravity stamps, arranged in two groups of eight four-stamp batteries. The building was approximately 180' x 100' and the stamps were mounted along the long western wall. The main mill building also contained most of the washing equipment, where the copper was separated from the waste rock. A small boiler house attached to the mill building contained the steam generating equipment that powered the stamps as well as a high capacity pump that supplied water from Portage Lake to the stamps and the boilers. A tailings wash house, located about 250' east of the mill, contained washing equipment and a set of burr stones for regrinding some of the waste from the mill. The wash house was connected to the mill by means of an elevated launder. A sand wheel located in the mill building lifted the tailings to the launder. The sand wheel also served to raise the waste sand wheel also served to raise the waste sand to enable it to get a longer fall and thus carry it farther away from the mill site.[8]

Quincy transported its rock from the mine to the mill by means of a gravity operated tramway that ran along the line of shafthouses and then descended to the side of the mill building. In 1862 the tramway was approximately 3,500 feet long. A double track provided for the return of empty cars from the mill to the hilltop.[9] The weight of the loaded cars descending the hill provided the power to pull the empties up. There is little information available on the operation of the tramroad. It is not known, for example, how the fall of the heavily laden tram cars was controlled. Apparently one loaded car was counter balanced by two empties. There is also a mention of the construction of a new drum house in the 1863 Annual Report. This drum house seems to have housed at least part of a mechanical winding system. If this is the case, there was probably a manually operated brake band on the cable drum.[10]

The tramroad worked almost daily from 1860 to 1892 and gave good service for the thirty-odd years it was in operation. The only disruptions in service involved periodic maintenance and the infrequent major overhauls the company performed on the road. The tramroad was extended several times to provide connections to new shafthouses, but the basic route remained unchanged.[11]

There are very few references to specific equipment used at the

Quincy mill, and no attempt will be made to speculate on the exact type of machinery that may have been installed. However, since the process was essentially the same as at other mills in the area, it is possible to reconstruct in some detail many of the operations. This survey will focus on the year 1865. By then, the installation of most of the major pieces of equipment had been completed, but none of the equipment was old enough to have been replaced or extensively remodeled.

Contemporary maps and photographs of the mill seem to suggest that the stamp batteries, units of four individual heads, were arranged along the building's long western wall. The rock bins were above and behind the stamps. The tram cars dumped their load of rock into these bins when they reached the bottom of the incline. The exact mechanics of the unloading process are unclear. The tramroad track certainly extended into the mill building and over the rock bins where the cars were emptied. Since the stamps were divided into two distinct groups, there were undoubtedly two rock bins.

The rock was fed from the bins to the stamps on wooden chutes, one for each battery of stamps. It was a gravity feed system, the flow being controlled by an individual known as the "head feeder." His job was to insure the steady flow of rock from the bins to the stamp heads. These men must have been experienced mill hands because the job was vital to the efficient operation of the heads. Ideally, the feed was slow and steady, but the head feeder had to be alert for variations in the size or hardness of the stamp rock, since changes in either of these areas could affect the rate of flow. The larger or harder pieces required more time to stamp properly, and the flow would be slowed accordingly.[12]

The mill pump supplied water to the stamp mortars. The earliest pumping equipment at the mill consisted of one single and one double pumping engine, of unspecified manufacture and capacity. A boiler plant generated the steam that powered the pumps, but there is no information available as to its equipment or construction. Apparently, the boilers and pumps were installed in an annex attached to the western side of the mill building. The few extant photos show a smokestack rising from that side of the building.[13]

The stamp rock and water were mixed in the stamp mortar, where the actual crushing of the rock occurred. The stamps the Quincy Mining Company used in its mill were gravity stamps, brought to the Lake copper region by Cornish miners as early as the mid-1840s. Gravity stamps operated on the principle of the mortar and pestle. The stamp heads were lifted by cams and dropped by their own weight. A single battery of stamps at the Quincy mill consisted of a mortar, roughly three feet by one foot, and four stamp heads, each approximately ten inches by eight inches. The batteries were probably about ten feet high. The Quincy mill was equipped with sixteen batteries of stamps, a total of 64 heads.[14]

A steam engine rotated the two main drive shafts, one for each side of the mill. The individual batteries were connected to the main drive shaft by means of a belt which in turn rotated the battery drive shaft. Cams were attached to this drive shaft. These cams engaged lifters on the stem of the stamp itself. The cams were designed so that after the stamp had completed its travel and had reached its maximum height the cames and lifters disengaged and the stamp fell into the mortar. Dry ore was fed into the mortar from the rock bins. Water entered the mortar through a separate inlet. The two long sides of the mortar box were formed of several layers of sheet steel screens, drilled with 5/8" holes. These screens allowed only those particles that had been crushed to the desired sixe to leave the mortar.[15]

The crushed rock was carried from the stamps to the head box by launders. The head box was simply a wooden receptacle that received the product of several stamps and distributed it to a number of hydraulic separators. The only moving parts were a set of valves that regulated the flow of the water and rock mixture to the separators. It is likely that all the stamps on one side of the mill (eight batteries) fed into a common head box.[16]

Classifiers were preliminary sorting devices that separated the rock into progressively smaller particles. All of the classifiers had a carrying current, that is, a current of water that carried forward whatever particles of material that remained suspended in it. The heaviest particles sank first and the smaller pieces gradually settled out as the force of the carrying current weakened. The variously sized particles of mineral were removed through a series of four spigots that fed launders carrying the material to the jigs. The sixe of the particle determined where it entered the jigging process.[17]

The jig used almost universally in the Lake Superior region was the wooden Collom jig. The usual installation of this machine consisted of two sets of double-celled jigs. A single jig was a wooden box about seven feet long, three feet wide and two feet high. The box was divided into three vertical sections by wooden partitions. The center section housed the plungers that made the jig work. The two outer sections contained sieves that did the sorting and separating.[18]

The sieves were mounted in the jigs leaving a space above and below the sieve plate. Rock from the separator spigots entered one end of the jig and settled on the sieve. The moving parts of the jig consisted of two wooden plungers mounted on shafts. A rocker arm actuated the shafts and plungers and their action caused the water in the sieve chambers to rise and fall with their pulsations. The motion of the water caused the material on the sieves to become suspended in the water. As this material settled, the desired separation occurred.

Material that was too large to pass through the sieve settled on the plate in order of its specific gravity, the heavier materials on the bottom, the lighter ones on top. Particles smaller than the openings in the sieve passed into the lower chamber. The length of the travel of the plunger determined the suction created in the sieve chambers, and this in turn determined the weight of the material that was able to settle between pulsations. Material that was unable to settle because it was too light flowed out an opening in the front of the jig into the next jig in the process. This jig was set up to treat smaller sized and lighter weight material.[19]

Jigs were identified by the "mesh number" of their sieves. This mesh number referred to the number of openings per inch on the sieve. Thus, number eight mesh had eight openings to the inch, number ten had ten, and so on. Number eight mesh had openings of 1.52 millimeter; number thirty mesh, in most cases the smallest mesh used in the Lake region at this time (1865) had openings of 0.37 mm.

Jigs were connected in series, arranged according to decreasing mesh size (or increasing mesh numbers). In practice the actual order varied, but it was usually arranged so the first two cells of the next lower machine had the same sized sieves as the last two cells of the previous machine, thus: 2-4, 4-6, 6-8, 8-10, and so on. In some mills, but not Quincy's Portage Lake facility, there were two sets of jigs, roughing jigs with sieves of perhaps two through ten size, and finishing jigs with sieves of fourteen through thirty. The fact that a jig could be very precisely "fine-tuned" is obvious: the difference between six-mesh and eight-mesh is .64 millimeter.[20]

The product of the jigs divided automatically into three classes. The material settling directly on the screen was relatively clean pieces of copper called "headings." The particles that settled on top of the headings were considered waste rock, or "tailings." Material heavy enough to pass through the sieves into the lower compartment, "middlings," was drawn off for further treatment. The light weight material that passed out the top and front of the jig was also middling. Normally, the name middling was given to any material that went elsewhere for further treatment.[21]

The sieves were cleaned several times in a ten-hour shift. Headings went to the mineral bin, middlings were passed on for further treatment, and the tailings were deposited in the waste launder. The launder carried them to the sand wheel. From there they were either dumped into Portage Lake or sent to the wash house for regrinding and further treatment.

The middling from the last set of jigs was treated on some form of wash table. At Quincy the mill superintendent, Philip Scheuermann, installed a table of his own design called the Scheuermann Washer. There is no information available about these washers, except for several references extolling their good and efficient operations.[22] Other tables, which Scheuermann must have used as a model for his own, usually provided a gently sloping surface that was kept in motion. Most of the copper remaining in the table feed settled out on the table and was collected. The run-off from the wash tables was treated once more on another device.

At Quincy the final step in the milling process was treatment on several "Evans Patent Rotating Slime Buddles." The material handled on these buddles included the run-off from the washers and the waste from the hydraulic separators. These materials were called "slime," a term applied to most of the liquid product of the milling process. Slimes usually carried minute particles of copper which would not settle out at any other point in the process. At the buddle, the slimes were fed very slowly over a rotating disc. The heavier particles of copper settled out and were collected. Any material that ran off the buddle went to the waste launder for disposal.[23]

The sand wheel, which handled almost all of the waste products generated by the mill, was apparently located in the southeast corner of the mill and was connected to the tailings wash house by means of an elevated launder. The sand wheel, 26 feet in diameter, was built in 1864 by Philip Scheuermann. The wheel was probably powered by the mill's steam engine, since the flow of the waste was probably insufficient to turn the wheel by itself. Furthermore, the wheel could not have been over shot, because in that configuration it would have been redundant. The purpose of the wheel was to raise the sands to the launder.[24]

Between 1865 and 1892, the Quincy Mining Company made periodic changes in the equipment and processes it used at its Portage Lake facility. Some aspects of the mill operation obviously received more attention than others, but in general the whole plant benefitted from regular renovations.

The boiler plant was subject to yearly maintenance, although at irregular intervals the boiler tubes were replaced. In 1870, the boilers were thoroughly overhauled, cleaned, and remounted.[25] By 1882 the boilers were again ready for major repair work. The company's agent, Frank G. White, recommended the purpose of new boilers, and suggested that the company erect a new stone building to house them.[26] The agent's recommendations were followed and two Wickes boilers were installed in a new boiler house in 1883. A third boiler was added the next year. The old boilers were finally removed in 1884.[27] The original pumps appear to have served until 1887, when they were replaced by a new Worthington compound pump - "size 14/20" x 7" x 12"."[28] These were the only major changes made to the power and water supply departments. Thus, the system remained essentially the same from 1860 to 1892.

The regular maintenance of the mill was an expensive proposition. The stamp shoes had to be replaced almost weekly, and sixty-four stamps could go through a great number of the expensive iron shoes in a year. Once each year the entire mill was shut down for two or more weeks, usually in the early spring, for extensive repairs. The Quincy Company took advantage of these periodic shutdowns to make more extensive technological changes in the mill.

Many of these changes reflected Quincy's desire to do a more effective job of treating its copper. Between 1865 and 1892 Quincy added additional washing equipment in an effort to recover finer and finer particles of copper.[29] In 1868, Quincy agent James N. Wright obtained management approval to "add another set of washing machines on one side of the mill, for treating finer grades of mineral, and hope thereby to effect a still further saving of both labor and metal."[30]

By 1876, the problem of copper loss in the wastes made it essential that extensive changes by made at the mill. According to agent A. J. Corey:

> The falling off in percentage of mineral smelted is entirely confined to the No. 3 grade of stamp copper, and is caused, I think, by a lack of copper facilities for handling and washing the increased quantity of rock stamped. We are now making preparations to remedy this difficulty by the introduction of labor saving machines on the wash floors, putting in twelve additional Scheuermann washers and four Evans Slime tables, which should not only cheapen the cost of washing, but dress the low grades of mineral to a higher percentage and save more fine copper than we can possible do by our present mode of working.[31]

These changes were made in 1877 and were so extensive that they necessitated the building of a new addition to the mill, probably by expanding toward the east.[32] These expenditures, amounting to roughly $22,500, bore fruit in 1878, when the company reported lower costs for stamping rock and a higher yield per ton of rock stamped. Between 1887 and 1892, the company had increased the yield of its rock by more than a full percent, from 2.11% to 3.21%.[33]

Even with these improvements, the mine produced more rock than the mill could stamp. The limitations of the mill placed an artificial constraint on the amount of rock the company brought from the mine. In an effort to increase production the company installed two new batteries (eight heads) of gravity stamps in 1880. These new heads brought the total number in service to eighty, and raised the daily capacity of the mill to 350 tons.

The one facet of mill operations unique to Quincy is directly related to the problem of mill capacity and efficiency. The Quincy mill was the only large scale mill in the region to use gravity stamps. The other major mills in the area used some form of Ball's steam stamp. Proponents of the steam stamps argued that they were more economical and more efficient than the gravity stamps. Quincy disagreed, and for good reason.

Gravity stamps are one of the oldest intermediate and fine crushing devices known. Agricola, in De Re Metallica (1556) described the operation of a gravity stamp mill and included a drawing of a battery that must have appeared very similar to the ones installed at the Quincy location. The earliest gravity stamps in Michigan were made almost entirely of wood, since wood was plentiful and inadequate transportation facilities made it virtually impossible to obtain parts made of durable iron and, later, steel. However, as transportation facilities improved, most users adopted the metal fixtures.

The most improved model of the gravity stamp featured a square or round steel stem with an adjustable collar. This enabled the mill operator to regulate the length of the fall of the stamp, allowing it to handle different sized rock. The head of the shaft was made of chilled iron. The stem fit into the head by means of a slight taper.[34]

Gravity stamps were crushing devices capable of taking a coarse feed and yielding a fine product. It was possible to feet a mill lumps three inches in diameter and to receive particles finer than 1/50" at the mortar discharge. On the other hand, the capacity of the gravity mill was small in relation to the weight, cost, and size of the machine. A batter weighed approximately 3,200 pounds and cost between $600 and $800.[35]

TABLE 1[36]

Technical Data on a Typical Gravity Stamp, c. 1900

Weight of Battery: 3,200 lbs.
Weight of Head: 125 lbs.
Size of Head: Approx. 8"x10"x6 or 9-10" diameter
Height of Drop: 5-6"
Drops per Minute: 50-100
Weight of Head, p.s.i.: 15 lbs.
Crushing Pressure, average foot pounds p.s.i.: 8
Velocity of Hit: 9 feet per second
Water use: per head per minute: 4 gals.
per ton of rock stamped: 8 gals.
Capacity per Battery per 24 hrs.: 17-18 tons

It should be noted that these figures refer to the most improved version of the gravity stamp. Quincy would have been extremely fortunate to obtain figures as high as those given here.

Quincy purchased its first batteries of stamps from the J. B. Wayne Company of New York. Wayne apparently visited the Quincy location to direct the installation of the stamps in 1859. However, most of the replacement parts, such as heads and cams, came from foundries in Detroit, Marquette, and Houghton. In November 1860, Quincy purchased a battery of four Wayne stamps complete with rods, collars, cams, dies, and shoes from the Eagle Works, Portage Lake, Michigan. The Eagle Works seems to have manufactured the stamps under some kind of a licensing agreement with the Wayne Company. By 1862, Quincy was apparently satisfied that it had made all the additions and improvements it could to the Wayne stamps; until 1880 the only stamp parts purchased were replacement shoes, shafts, cams, mortar boxes, and screens. Throughout the period, the stamps were rebuilt several times, but no attempt was made to replace the stamps with the more modern and allegedly more efficient steam stamp.[37]

Large steam stamps were introduced into the Lake Superior region as early as 1856. One version, the Ball, gained almost universal use in the district during the seventies. By the mid-1860's, the Ball was in operation at several mills, including the Pewabic and Franklin Mining Companies mills on Portage Lake. The primary advantage of the steam stamp was that it subjected the rock to a very heavy pounding. It broke the rock very quickly and was therefore able to crush many times more rock per battery than a gravity stamp.[38]

In construction and operation a steam stamp was very similar to a gravity stamp. The major parts of both were the same: shaft, head, mortar, etc. The major difference was that steam, not gravity, provided the power that forced the head onto the rock. Rather than relying on a system of shaft and stem cams to lift the head, the steam stamp used either the force of the recoil of the head rebounding off the mortar die or high pressure steam to lift the stamp. The stamp steam was part of the piston rod of a reciprocating steam engine. The steam forced the head of the stamp down with an accelerating motion, reaching its maximum velocity at the time it struck the blow.[39]

TABLE 2[40]

Technical Data on a Ball Steam Stamp, c. 1900
Weight of Battery: 4,500 lbs.
Weight of Head: 600 lbs.

Size of Head: 22"x14"x8"
Height of Drop: 25"
Drops per Minute: 95-110
Weight of Head, p.s.i.: 18 lbs.
Crushing pressure, average foot pounds, p.s.i.: 17,000
Velocity of Hit: 20 feet per second
Water Use: per head per minute: 160 gals.
per ton of rock stamped: 5.5 gals.
Capacity per Battery per 24 Hours: 300 tons

The comparison between Table and Table 2 is striking. The steam stamp had ten times the capacity per day, applied more than two thousand times the crushing pressure, and used less water per ton of rock stamped. Clearly, the steam stamp was a much more powerful crushing device. Proponents claimed that it was also more efficient than the gravity stamp. The operations of the Quincy Portage Lake mill suggest that this claim was probably false.

Quincy was under constant pressure to justify the continued use of an older technology. Quincy claimed that the gravity stamp was more efficient because less copper was lost in the wash process:

> The stamp mill has done good duty, and although the cost per ton of rock treated may not compare favorably with that of mills of recent construction, yet it is the opinion of many who have given the subject close attention, that the cost of stamping with Ball's head is more than offset by our saving of fine copper. It is believed that the heavy blows of the Ball's stamps on such rock as we are mining would so pulverize and abrade the particles of mineral contained therein that much more copper would be carried out with the sand and lost, than there is at present. Our mill has always shown superior results in the saving of fine copper.[41]

Quincy's cost per ton of rock stamped was frequently higher than that of other mills equipped with steam stamps. However, Quincy was consistently a leader in the percentage of copper recovered per ton of rock stamped. Therefore, a better comparison can be made when one considers the stamping cost per pound of mineral produced. On this basis, the Quincy stamp costs were consistently as low or lower than the steam stamp costs. Quincy was willing to accept a higher cost per ton of rock stamped because it was able to recover more copper at a cost per pound that was in line with other operations in the area.

Table 3 compares the stamp mill operations of the Quincy,Franklin, and Pewabic Mining Companies. Since these three companies all worked the Pewabic vein, it is safe to assume that the stamp rock was basically the same at all three mills. The Quincy mill had 64, and later 80, heads of gravity stamps. Pewabic and Franklin each had three heads of steam stamps.[42]

The alleged inefficiency of Quincy's milling procedures was a topic of great dispute in the "Copper Country." In 1867, Henry McKenzie, the editor of the Portage Lake Mining Gazette, claimed that he "saw more fine copper in the Quincy mill sand bank than on the Franklin and Pewabic mill sand

TABLE 3
Comparison of Stamp Mill Operations

	Quincy	Pewabic	Franklin
1862			
Tons of Rock Stamped	42,633	37,268	
% cu. per ton of rock stamped	2.03	1.67	
Cost per ton of rock stamped	$1.02	$0.835	
# cu. from stamp rock	1,730,900	1,244,751	
Stamp cost per # cu. produced	$0.0251	$0.0250	
1866			
Tons of Rock Stamped	49,903	39,864	
% cu. per ton of rock stamped	2.63	1.63	
Cost per ton of rock stamped	$1.667	$1.75	
# cu. from stamp rock	2,624,898	1,299,566	
Stamp cost per # cu. produced	$0.0317	$0.0537	
1867			
Tons of rock stamped	37,774	46,000	51,356
% cu. per ton of rock stamped	2.74	1.80	1.13
Cost per ton of rock stamped	$1.683	$1.107	$1.247
# cu. from stamp rock	2,070,015	1,656,000	1,160,645
Stamp cost per # cu. produced	$0.0307	$0.0308	$0.0552
1868			
Tons of rock stamped	36,557	42,494	43,028
% cu. per ton of rock stamped	2.25	1.60	2.22
Cost per ton of rock stamped	$1.28	$1.211	$1.31
# cu. from stamp rock	1,645,065	1,359,808	1,910,443
Stamp cost per # cu. produced	$0.0284	$0.0378	$0.0295
1882			
Tons of rock stamped	101,327	63,592	148,042
% cu. per ton of rock stamped	3.21	1.51	1.68
Cost per ton of rock stamped	$0.716	$0.649	$2.35
# cu. from stamp rock	6,505,193	2,136,691	4,974,211
Stamp cost per # cu. produced	$0.0112	$0.0193	$0.0703
1887			
Tons of rock stamped	94,250		173,874
% cu. per ton of rock stamped	3.23		1.37
Cost per ton of rock stamped	$0.576		$1.87
# cu. from stamp rock	6,088,600		4,764,148
Stamp cost per # cu. produced	$0.0089		$0.0682

Note abbreviations used:
cu.: copper
\# : pounds

banks together." In reply, Philip S. Scheuermann, Superintendent of the Quincy mill, offered McKenzie the opportunity to rework these sands with the understanding that he could keep all the copper he recovered. Unhappily, it appears that McKenzie never took Scheuermann up on his generous offer, leading one to question how legitimate the original claim was.[43]

Another incident supports the thesis that there was less copper in the waste sand than some believed. From the earliest days Quincy allowed individuals, "tributors," to rework the waste sand to recover copper that had been carried out as waste. For the privilege, the tributors gave Quincy a percentage, usually 40%, of the copper they recovered. In 1878, after Quincy had expanded the mill to accommodate more washing equipment, agent A. J. Corey was able to report that "our tributors in the tailing wash house [are] barely making miners wages, and [are] paying neither tribute nor rent."[44] One must assume that the tributors were using the most advanced methods available to them to recover the copper, since this was their livlihood. If, in the face of their best efforts, they were able to eke out no more than a meagre living from Quincy's waste copper, it seems reasonable to assume that the criticisms about the inefficiency of Quincy's stamps and mill were at least overstated.

There were factors beyond mill operations that influenced the percentage yield of copper per ton of stamp rock. Quincy shipped only high grade rock to the mill, and left much low grade rock below ground. Quincy was aware that it was pushing its mill to the limits and that it had to stamp only the best rock to make optimum use of the facility:

> The mine is equal to supplying a large quantity of low grade rock in addition to what is now treated, and which should be mined and milled with the higher grades which have been stamped during the past two years [1879-1880] but the mill having been worked to its full capacity no increased duty was possible.[45]

For whatever reason, the Quincy mill was undoubtedly one of the most efficient stamping facilities on the Keeweenaw Peninsula. Unfortunately, its relatively small size and low capacity made it a bottleneck that served to limit mine output. Quincy tried to alleviate the problem in 1880 when it installed four more batteries of gravity stamps, but this was at best a temporary expedient. Mine production expanded to again tax the milling facility. By the middle of the 1880's the company was actively considering the erection of a new mill. When the decision was finally made, Quincy opted to install steam stamps. Quincy needed their greatly increased capacity, and was willing to trade-off some stamping inefficiency to get it.

Quincy apparently maintained the Portage Lake facility as long as it did because it was unwilling to stand the extraordinary expenses mill construction would involve. Quincy could not simply install a steam stamp in its existing facilities. A steam stamp required a very sturdy foundation because of its great weight and power. The mill was set up to handle the lighter, less powerful gravity stamps. To have installed even a single steam head would have necessitated the construction of extensive, expensive new facilities. While copper prices were relatively high Quincy was content to accept a reduced output that gave arelatively high yield. When copper prices fell, it became essential to process as much copper bearing rock as possible. For quantity, nothing could top a number of steam stamps. With this in mind, Quincy finally adopted the steam stamp. Until that time, old, well-proven, and profitable systems were "good enough."[46]

This policy of financial and technological conservatism, whether justified or not, was a hallmark of the management of the Quincy Mining Company, especially during the incumbency of company president Thomas F. Mason, who held that office from 1861 to 1899. Despite the reluctance to become a leader in the adoption of new technologies, the Quincy Mining Company maintained its position as the leading producer of amygdaloid from 1860 to 1830. Quincy seldom tried anything drastically innovative, at least in milling technology, but it used the equipment it had to good advantage.

Throughout the thirty-two years of its service to the Quincy Mining Company, the Portage Lake mill did steady, dependable work, as Table 4 demonstrates.

The labor force at the mill reflected the diverse ethnic make-up of the Quincy work force as a whole. Throughout the 1860's and 1870's the stamp mill work force was dominated by persons of German and Irish descent, although several

TABLE 4
Operations of the Quincy Stamp Mill, 1861-1889[47]

Year	Rock Stamped (Pounds)	Stamp Copper (Pounds)	Cu. Per Ton of Rock Stamped	Mine Output (Pounds Cu.)
1861	37,776,000	955,396	2.55%	1,841,708
1862	85,266,000	1,730,670	2.03	2,505,472
1863	94,890,000	2,811,560	2.96	2,945,472
1864	101,340,000	2,784,370	2.75	2,971,462
1865	97,114,000	2,524,813	2.60	2,721,980
1866	99,806,000	2,621,785	2.63	2,760,014
1867	75,488,000	2,068,885	2.74	2,248,279
1868	73,114,000	1,645,130	2.25	1,774,351
1869	119,534,000	2,816,900	2.48	2,932,054
1870	110,054,000	2,873,255	2.61	3,045,676
1871	119,514,000	2,739,685	2.29	2,932,222
1872	121,656,000	2,602,245	2.14	2,804,954
1873	126,544,000	3,289,025	2.60	3,423,827
1874	134,400,000	3,505,530	2.61	3,621,405
1875	141,002,000	3,435,395	2.44	3,527,315
1876	148,380,000	3,531,115	2.38	3,661,715
1877	150,614,000	3,173,030	2.11	3,304,580
1878	N/A	N/A	N/A	3,408,925
1879	N/A	3,216,125	N/A	3,335,115
1880	N/A	4,711,675	N/A	4,878,610
1881	197,738,000	6,193,190	3.13	6,815,485
1882	202,654,000	6,508,410	3.21	6,874,230
1883	194,200,000	6,535,045	3.36	6,535,045
1884	198,392,000	6,490,185	3.27	6,885,200
1885	216,362,000	6,604,125	3.05	7,019,805
1886	219,404,000	6,748,785	3.08	7,153,500
1887	188,500,000	6,092,475	3.23	6,743,510
1888	235,028,000	7,141,570	3.04	7,762,945
1889	235,470,000	6,641,785	2.82	7,820,010

other nationalities were represented on the labor rolls. Work in the boiler house was shared by a machinist and a helper, three "engine drivers" and one helper, and two firemen. Maintenance was handled by three carpenters, a porter, a blacksmith and helper, and a cooper. In the mill itself five men cleaned barrel work (fist-sized pieces of copper with some attached waste rock), five tended the stamps, and thirty-six worked on the wash floor. The labor force increased as output increased, but the job classifications remained the same between 1860 and 1892. Labor costs at the mill totalled approximately $1,800 in May, 1869; for the year the total cost of labor at the mill was over $200,000. By 1877, this figure had declined to $17,500, although it should be noted that the mill was closed for one month that year. The total labor force varied greatly, ranging from an average of less than 60 men per month in the 1860's to an average of about 85 men per month in the 1880's. A man usually worked 28-30 days for eleven months: anyone not needed for the mill repairs received an unpaid vacation in the early spring.[48]

The Quincy Mining Company finally had to consider relocating its mill when the tailings began to encroach on the Portage Lake navigation channel. Also, Quincy was planning some major land acquisitions (the Pewabic property) and it knew that it would have to increase its stamping capacity. Waste disposal had been a problem almost from the beginning. In 1863, the company purchased two wooden scows that were apparently used to haul waste material to other unspecified dumping sites. The Portage Lake Towing Company was paid almost monthly throughout the navigation season for "towing dredging and dumping scow." The tugboat "Pratt" seems to have been used extensively for this task.[49] In 1867, the company was forced to build a bulkhead "to prevent our waste sand from the stamp mill encroaching on our neighbors." This bulkhead was extended several times, but it did not solve the problem.[50] By the mid-1880's, the Quincy Mining Company clearly saw a need to build a new more efficient mill with more space for waste disposal. Construction began on a new mill on Torch Lake in 1888, and it opened in 1890.

Before examining the construction and operation of the Torch Lake mill, it will be of interest to discuss the fate of the old Portage Lake facility. Soon after the opening of the new mill, it appeared that the Portage Lake mill would be shut down almost immediately, as the company put on double shifts to reduce the stockpile of stamp rock at the mill.[51] Company agent S. B. Harris wanted to take some action on the mill: he especially wanted a decision made on whether the old woodwork would be torn up to recover the copper he believed it held. By early April, 1890, he reported that the mill had about one week's supply of stamp material left, so he was willing to "wait and see."[52]

At that time, however, the price of copper was high (approximately 16¢ per pound) and company president Thomas F. Mason wanted to increase the product of the mine. He advised against shutting the mill down for some time.[53] As Mason was suggesting this option, Harris decided to keep the old mill in operation until a third steam stamp head could be erected at the new mill. Harris planned to give the old mill roughly half of the total mine product, and assured Mason that the waste disposal problem could be handled by using scows to haul away the tailings, which would be dumped elsewhere.[54] Mason approved, and gave Harris a free hand to determine exactly when to stop work at the old mill.[55] The exact date when operations ceased at the old mill is not known, but by August 1,1893, Harris was able to report that "the work of dismantling the old stamp mill ... is being pushed as fast as circumstances will permit.[56] Quincy erected a new stone pump and boiler house on the site of the old mill. This facility supplied water to the mine site.[57]

III

The Torch Lake Complex, 1888-1931

The decision to change mill sites was based on economic and technical reasons; the timing of the change was based on environmental reasons. The management of the Quincy Mining Company realized at least as early as 1884 that conditions at the mine would necessitate the modernization of the mill plant. It appears that the impetus for the change came from agent S. B. Harris. On October 4, 1884, he wrote to President Mason:

> It is all very fine while these abnormally large bodies of copper continue, but we can't expect them to last forever, and with only ordinary good stamp rock - with but little mass and barrel copper - we could not keep up much of a product with our present stamping facilities.[58]

Mason apparently believed that the most economical way to avoid the problem that Harris mentioned was to obtain the services of an existing mill. In early 1885 he went so far as to tell Harris to obtain from the agent of the Osceola Mining Company an estimate of the selling cost of their mill on Torch Lake. When Osceola asked for $100,000, Mason stopped any further negotiations with a curt " When we pay that amount for increased facilities, we will 'put it where it will do the most good.'"[59]

Harris continued to agitate for a decision on new milling facilities - too hard, however, for some of the officers of the company. Harris was apparently very critical of the Portage Lake mill in his report for 1885, because William Rogers Todd, secretary-treasurer of the company, found it necessary to delete Harris' comments and insert the usual "The stamp mill has done good duty . . ." statement in its place. He explained his actions to Harris:

> The old mill, although we know it is defective, has we think been too much the subject of general abuse and we are of the opinion that if an honest comparison could be made, would hold a more favorable position than the friends of the Ball stamps admit. It has rattled and pounded away for 25 years and now in its old age would like to give it a good word if possible, as well as to give its opponents that have been hitting it so hard and long a little blow as a parting salute.[60]

It is obvious that the management of the company knew the existing mill capacity was insufficient and that some change would have to be made. As usual, however, the wheels of progress turned very slowly at Quincy, and it took the pressing problem of waste disposal to force Quincy's hand.

Mason knew the company's practice of dumping its waste in narrow Portage Lake could eventually create some "environmental" problems. He expressed the fear passage of the River and Harbor Bill of 1886 could force the Quincy Company to "put a stop entirely to our present modes of disposing of the sand."[61] This threat finally forced Quincy to begin looking for a new mill site in 1887.

Portage Lake is a narrow, twenty mile long body of water that bisects the Keeweenaw Peninsula. For most of its length it is rarely more than 800 to 1,000 feet wide, and in the stretch between Hancock and Ripley it is frequently less than 600 feet wide. The Quincy mill was located on this corridor of the lake. Aside from being the water link between the mines and their markets, Portage Lake also served as a haven for lake ships during storms on Lake Superior. As the stamp mills on the lake continued to dump more and more waste sands, the Federal Government saw a serious threat to free navigation on the lake. Therefore, in the 1880s the government established minimum harbor lines. Any company that continued to dump sands beyond these harbor lines was in violation of federal law and subject to heavy fines.[62]

Although Mason had hoped to defer making a decision "for two or three years," he realized the company could not afford to delay much longer. From his New York office he offered Harris the choice of three locations where he hoped to build a new mill. The first was Dollar Bay, several miles east of the old mill but still on Portage Lake. He was not hopeful of securing this site because he feared that "our Boston friends have probably corralled everything desirable at that point." The "Boston friends" were rival copper companies whose offices were in Boston. His second choice was "Sweed Creek" [Sic. He is apparently refering to Swedetown Creek.], west of the existing plant but again still on Portage Lake. His final suggestion was to move the mill to a higher location at the present site. His only objection to this was that the expanse of raising water to the new mill would be high.[63]

Harris, in reply, appears to have suggested other locations. Mason agreed to have them surveyed, but continued to push for either the "Sweed Creek" or Quincy Hill sites.[64] Whatever the site, Mason envisioned that the new mill would be a duplicate of the old one:

> If we should only change the mill to a higher level, same locality, it would, no doubt, be well to make such changes as seem to be required (as the result of past experience) but on the other hand if you have concluded that we must seek another locality I suppose you may conclude it best to simply build up about as it was, as that, probably, would be cheaper and more rapidly done.[65]

As events were to show, Harris did not plan to use the old mill as a model for the new one.

Acting on advice from Mason, Harris commissioned a survey of three of the more likely mill sites, with an eye toward determining the transportation requirements necessary to connect the mill with the mine. The report made no recommendations, but reported that all the sites could be reached relatively easily by railroad. The report ended with the admonition that before any site were chosen "some definite understanding should be obtained from the Government as to the width of the channel or harbor lines." The site finally chosen was not one of the three surveyed locations.[66]

After a visit to the mine, Mason decided that given Government regulations barring the blocking of navigation channels, "there would be no safety in attempting to find a future up the Lake." He therefore decided to secure some waterfront property on Torch Lake. He asked Harris to choose the site; he would take care of the land purchases.[67] Torch Lake is an inland lake at the same level as Lake Superior. It forms an extension of Portage Lake. It has gently shoping banks, but the lake itself falls off sharply from the shore, reaching a depth of 120 feet. This made for ample storage room for tailings with the tonnage concentrated in a limited area.[68] Quincy purchased a large plot of land on the northwestern shore of Torch Lake from the estate of Ransom Shelden, as well as several smaller plots of land from other private owners. The total purchase encompassed an area of something more than 300 acres.[69]

Construction activity at the new mill site began in the spring of 1888. Mason hoped to begin operations in the summer of 1889, but construction dragged on until 1890. Mason journeyed to Michigan in May, 1888 to help chose the exact site of the mill on the Torch Lake property.[70] Mason had good reason to push construction: the federal government had filed suit to stop the company from dumping material into Portage Lake. Mason expected to receive orders to "get out from Portage Lake on short notice."[71] Fortunately for Quincy, the new mill, although late in opening, was ready in time to prevent any interruption of the milling operation. After much discussion and several false starts, Quincy had its new mill.

The Quincy mill site on Torch Lake exhibited many of the features seen at the Portage Lake facility. The mill building itself had the same sloping roofline, exaggerated in this case because the building was built in a series of steps. There was a pump house and a boiler house, constructed some distance from the mill building itself. The Quincy and Torch Lake Railroad served as a powered tramway, hauling rock from the mine to the mill and coal from the docks at the mill to the mine. There were also extensive coal handling facilities at the mill. In every sense, it was typical of a modern stamp mill.

Inside, however, the Torch Lake mill was significantly different from its Portage Lake predecessor. The

Torch Lake mill was equipped with two, then three, then five heads of Allis steam stamps. The mill featured increased washing facilities, and was significantly larger than the mill on Portage Lake. The larger size and better equipment contributed to a mill that had a much larger capacity than its predecessor.

Construction began at the mill site in August, 1888. The first building constructed was a boarding house, meant to house the construction workers on a temporary basis and designed for later conversion into a blacksmith, carpenter, and cooper shop. The company also built a dock, 200 x 32 feet, and a 5½ x 6 foot adit, which was meant to carry water from the lake to the pump house. The adit was approximately 600 feet long. A stone cistern, 50 x 7 x 17 feet, was built at the end of the adit. Excavations were dug for the foundations of the boiler house, pump house, and the mill building itself, and some of the foundation for the mill building was laid.[72] In 1889 the company erected six "substantial frame dwelling houses," a small warehouse, and an oil storage building, as well as a hoist at the dock and a tramway connecting the dock with the boiler house. Launders connected the boiler house to two small creeks 1,800 feet behind the mill, and in the same year workmen installed most of the mill's equipment, including the boilers, pumps, stamps, and washing equipment.[73] At the same time, the company built the six-mile long Quincy and Torch Lake Railroad to connect the mine and the mill. The railroad is discussed in detail in a companion H.A.E.R. report.[74]

The Quincy Mining Company Torch Lake mill presented a striking contrast to the Portage Lake mill site when it opened on March 19, 1890. Spacious, clean, and equipped with the most modern equipment, it was a far cry from the old, cramped, outmoded plant on Portage Lake. The mill and its attached support buildings and company housing constituted the new town of Mason, named after the president of the company. The area owned by the company was about one-quarter of a mile wide by one mile long. The site was level at the lake front but rose gradually until it attained a height of about 120 feet in the rear of the mill.[75]

The mill building was 198' x 120', of wooden construction, and contained, initially, two head of steam stamps, with a third added soon after the mill opened.[76] Fifty-six Collom jigs and eight double deck slime tables were installed on the wash floor. The stamps themselves were Ball steam stamps built by the Edward P. Allis Company of Milwaukee. The mortar for each stamp weighed approximately sixteen tons, and the complete stamp weighed 125 tons. A 14" x 36" Corliss steam engine powered the stamps; it stood on the northeast side of the mill.[77] Material from the rockhouses at the mine was transported to the mill by rail. The cars entered the mill on a trestle and dumped directly into the rock bins.[78]

The pump and boiler house was located on the south side of Torch Lake Road, presently Michigan Route 26.

The building was constructed of stone and measured 154 x 56 feet. It was divided into two compartments. One contained six Wickes boilers, with room for two more, plus an upright boiler-feed water heater. The other compartment contained an 8,000,000 gallon capacity Worthington pump. The pump had two 21" high pressure steam cylinders, two 42" low pressure steam cylinders, two 26" water plungers, all with a 36" stroke. The pump was located directly above the cistern that supplied water from the lake. A small hoisting engine and drum was installed on the second floor of the pump and boiler house; this was apparently part of the coal handling facilities.[79]

An elevated conduit connected the pump and boiler house with the mill. This covered "bridge" carried the water and steam pipes over the Torch Lake Road and also provided a passage way for pedestrian traffic. The waste launder from the mill also crossed the road at the same point, although the launder was mounted on its own trestle.[80]

Extensive coal handling facilities were erected at the dock, which had been dredged to 26 feet. Three large hoppers, each equipped with a coal hoist, ran on a track that extended the length of the dock. These hoppers were placed opposite the holds of the unloading ships. The hoists loaded the coal into the hoppers, which fed railroad cars that sat on a parallel track. This track led to the coal yard, where the cars were dumped. The coal yard was located southwest of the boiler house.[81]

Quincy took great care in planning its new facility and in choosing its equipment. The mine office sent out specifications to a variety of manufacturers. The proposals received were examined at the mine and at the New York office. The agent, S. B. Harris in this case, was usually free to place the order as he saw fit. Mason invariably deferred to Harris' choice, since he believed Harris had more technical knowledge and was acutely aware of what was required at the mine. Harris always informed Mason of his choice and sought at least pro forma approval.

The role of the New York office was to negotiate the finer points of the final contracts. For example, after much negotiation Mason signed a contract with the Worthington Pump Corporation for the 8,000,000 gallon capacity pump installed in the pump house. Mason had wanted to be sure that Worthington supervised the erection of the pump to insure the job was done correctly and at no risk to the Quincy Company. The final contract called for this procedure. Harris willingly allowed Mason to handle this phase of the contracting procedure.[83]

The Torch Lake mill was a major investment in an effort to establish a milling facility whose capacity was commensurate with the potential output of the mine. Between 1888 and 1894 the company spent $457,556 on the new mill location. The mill building itself was the largest single expense - $182,451, including the stamps and washing equipment. Tenements for the mill workers cost another $7,046, and the Mason school house cost $1,812.[84]

The Quincy Mining Company was justifiably proud of its new milling facility. In the space of about five years, Quincy had moved from an outmoded stamping system to one that was essentially "state-of-the-art." The installation was costly but it had a far greater capacity than the one it replaced. The three steam stamp heads processed almost as much rock as the eighty gravity heads but at a lower cost per ton and an equivalent cost per pound of copper produced. Quincy was very pleased with itself when it got its milling costs down to below $1.00 a ton in 1875; in 1898 milling costs were 22.28 cents per ton.[85]

The Torch Lake mill commenced operations on the afternoon of March 19, 1890. According to agent Harris, "everything work[ed] like a charm."[86] The production figures Quincy gave its stockholders are useless for the present purposes, because the company did not divide the total production between the two mills. However, the available correspondence does not provide any clues that the company was in any way dissatisified with the operations of the new mill. Harris reported few technical problems of any kind. Apparently the care put into the construction of the mill paid off. Everything seems to have "worked like a charm" for quite some time.[87]

As early as 1890, however, the company began to make additions to its milling complex. In that year, a 100' extension was added to the dock.[88] In 1891, another 400' was added. The boiler house was extended 40' to provide room for four new 6' x 16' boilers. A ten million gallon capacity Worthington high duty pump was installed in the pump house next to the eight million gallon capacity pump then in service.[89]

Significant additions were made to the mill building in 1891; the expansion of the pump and boiler facilities were the result of these changes. Quincy added two forty foot extensions onto the existing mill building to house two new steam stamps, purcahsed from the Allis Company. The two new stamps flanked the original battery of three, and were placed in service by the end of 1892.[90]

There was little additional construction in 1892, and in 1893 only minor changes were made. The principal work involved the construction of a tunnel between the boiler house and the mill. The steam and water lines that had formerly run between the two buildings on a trestle were now placed in the tunnel, "thus lessening the fire risk and saving many other annoyances."[91]

After 1892, Quincy's published production figures become a more meaningful guide for the impact of the new mill on mine output. The old eighty head mill did its best work in 1888, when it produced 7,141,570 pounds of mineral from stamp rock. In 1893 the new mill, with its five steam stamps in full operation, produced 11,765,000 pounds of mineral. By 1899 this figure had climbed to 13,439,205 pounds, at a total milling cost of $.0092 cents per pound of rock. The mill stamped 1,118,328,000 pounds of rock that year. At its best, the old mill never stamped more than 235,570,000 pounds of rock. These figures show how an impprovement in mill facilities enabled the mine to increase its output of rock by roughly 400%.[92] The percentage yield per pound of rock stamped declined, however.

The success of the new mill led to an increase in production at the mine. The mine was so successful in producing more rock that the company was forced to consider building yet another new mill. The key to the decision to expand mill facilities was the improvement made at shaft No. 2. As early as the spring of 1894, Mason advised Harris that the increased output of No. 2 would probably be more than the existing mill could handle, and that "a new mill will soon be required."[93]

(At this point, before going into the construction of the new milling facilities, it is essential to establish some guidelines for terminology that will be used in discussing milling facilities for the remainder of this report. In 1899 Quincy opened a new mill building on Torch Lake, just north of the 1890 mill. In Quincy usage, the 1890 mill was the "old" mill, the 1899 mill the "new" mill. To avoid any possibility of confusion, this report will hereafter adopt the following terminology. "Old mill" will refer to the Portage Lake mill (1859-1892). Torch Lake 1 or TL-1 will refer to the 1890 mill. Torch Lake-2 (TL-2) will refer to the 1899 mill. "The Torch Lake complex" will refer to all buildings standing on the Quincy property at Torch Lake at any given time.)

Mason visited the Torch Lake complex in the spring of 1894 to help select the site for TL-2.[94] The site he and Harris chose was located about 630 feet north of TL-1. Plans called for a building

132' x 216'. TL-2 would have three head of stamps initially, with room for additional stamps available. The plan for the site was similar to TL-1, reflecting the similar requirements of the milling processes in both buildings.

The Wisconsin Bridge and Iron Company built the mill building. It was to be ready by September 1, 1899 and cost $22,450. The building was of steel frame construction with corregated iron siding and roofing. Quincy originally wanted to construct another wooden building, but the metal structure was estimated to cost $2,000 less than a similar wooden building.[95]

The switch from wood to steel was made for several reasons, and seems to have been generally the practice for all mine structures built around the turn of the century. The steel frame structures were less susceptible to the ravages of fire. Throughout its history, the company had been plagued by a number of fires that had destroyed several rockhouses and other structures. The steel buildings were easier to maintain and would, theoretically at least, last longer. Finally, wood was becoming more expensive as companies had to go farther afield to obtain it. However, the switch to steel meant that the days when Quincy could contract for its construction work locally or do the work itself was over. I-beams presented construction problems the Quincy carpenters were ill-equipped to handle.[96]

TL-2 contained three Allis steam stamps, each with 20-inch cylinders. Each stamp fed 12 roughing jigs, 6 Wilfley finishing tables. [The Standard was a Wilfley-type table that featured a different motion.] The stamps had 3/16" screens in the mortar boxes. The mill was also equipped with a settling box, which fed slimes to the Wilfley tables. Regrinding was done on a Trent Chilean grinder, which served three jigs and three Wilfleys. The operations of these machines will be examined in more detail in the next section, since the process represented a great advance over the system that had been used at the old mill and something of an advance over the system in use at TL-1.[97] The mill commenced operations on December 5, 1900, when the first head was started. A second head entered service on December 26, 1900, and the third on January 9, 1901.[98] At least one authority claimed that TL-2 would have a daily capacity of more than 1,200 tons, and that to feed this mill the mine would increase its production by 40 to 50 percent.[99]

In order to operate its new mill, Quincy also had to build additional generating, water supply, and fuel handling facilities. A new boiler house provided the mill with power. The boiler house was a steel building, 56' x 90', that contained four Wickes 250 horsepower vertical tube boilers, with room for a fifth. Quincy's new pump house was of brick and steel construction, 54' x 54'. The pump was a 16,000,000 gallon capacity Allis vertical triple expansion machine. The pump and boiler houses were erected 360' in front of the mill building. A masonry tunnel connected the two auxiliary buildings and the mill. This 450' x 6' x 5-1/2' tunnel carried the steam and water pipes. A 100' x 7' x 7-1/2' adit carried water from the lake to the pump house. Finally, a 216' x 40' dock was built at the site along with a coal yard and other coal handling facilities.[100]

Torch Lake-2 and its attached facilities cost approximately $528,000. The Torch Lake complex (TL-1, TL-2, and construction in Mason) cost more than $1.5 million between 1888 and 1903. In that period, Quincy had constructed two efficient, thoroughly modern milling facilities, each equipped with the latest equipment. In some ways, the Torch Lake mills were similar to their Portage Lake predecessor. The processes were essentially the same and the facilities were surprisingly similar in both form and in function. The major difference was one of scale. The Torch Lake buildings were physically larger, but, more importantly, had a capacity that was many times greater than the old mill's. The adoption of the steam stamp was revolutionary (for Quincy); the new buildings and the technologies they housed were part of an evolutionary process that reflected the expansion of mining facilities and the concurrent necessity to be able to process more material more efficiently.[101]

After having suffered under a barrage of criticism about the old mill for almost half a century, Quincy was more than pleased with the Torch Lake complex as it stood in 1900. The Annual Report for that year offered a glowing summar of the past decade's work:

> We are pleased to announce to our stockholders that the betterments authorized, and begun some years ago, which have occasioned an outlay of over one and one-half million dollars are now completed, and paid for, and with the commencement of the year we have in successful operation two large, modern, well-equipped stamp mills, one with five heads, another with three heads of stamps, each capable of stamping and treating as much rock per head as any mill now running on Lake Superior. . . .

> The mining plant is all modern and mostly new, and with out mills, will compare favorably with the best, and we think our stockholders must soon realize from increased earnings, the wisdom the foresight of the management in all that they have done.[102]

The milling process as practiced at the Torch Lake complex around 1900 was in many ways similar to the techniques used at the old mill. However, a number of different technologies were added to increase the copper recovery capacity of the wash department of the mill. These new processes were necessary for two reasons. The steam stamps broke the rock into much smaller pieces, and more very fine pieces were released in the process. More importantly, the mill was processing lower grade rock. Rather than using only the highest grades of copper bearing rock, Quincy was removing most of the mineral bearing rock it found underground. This had the effect of lowering the yield per ton of rock stamped but also of increasing the total output. As agent Harris explained:

> In those days - the days of the old mill - the high grade rock only was stamped, otherwise the copper product could not be kept up. It was like picking the biggest apples - or digging the largest potatoes, and leaving the low grade for future generations to glean. We could not pursue that policy now if we desired to, because it would be impossible to get enough rich rock to supply the mill. We now, both from choice and necessity, mine large quantities of "low grade rock" and thus make money in many ways too numerous to mention.[103]

To briefly review the facilities that made up the Torch Lake complex in 1900, there were two mill buildings, the older containing five head of stamps, the newer, roughly 600' north of the other building, holding three heads. All the stamps were E. P. Allis

Company steam stamps, capable of crushing 600-800 tons of rocks per day. The stamps used seven thousand pounds of dry steam, at a pressure of 98 to 100 pounds p.s.i., per hour per head. The stamp shoes weighed 800 pounds when new and lasted about eighty days. When removed, they weighed about four hundred pounds. Each stamp made about 110 twenty-five inch strokes per minute. The die weighed 800 pounds and lasted six to eight months. When removed, it weighed about 250 pounds.[104] The stamp foundations were made of white oak timbers set on solid sandstone. These supported three cast iron bed plates of 22, 18, and 18 tons each. Each stamp was equipped with a two-way mortar; the grates were 9-1/4" wide by 49" long with 5/8" round perforations. Four screens were used on each mortar.[105]

The Quincy and Torch Lake Railroad delivered the rock to large receiving bins at the rear of the mill building. These bins were situated about 80' above the final set of Wilfley tables. An iron chute funneled the rock from the bins to the stamp mortar. The flow of rock in the chute was aided by a steady, rapid flow of water. An attendant, known as the head feeder, regulated the amount of rock entering the mortar and picked out some of the larger pieces of copper as they discharged from the mortar.[106]

An hydraulic mortar discharge was used on each stamp. Water flowed into the top of the mortar through a 3" x 4" opening. As this water pulsed through the mortar it effected a rough separation of the large pieces of stamp copper from the waste rock.[107]

The washing equipment was the same for each head. The undersize from the 5/8" mortar grates was delivered to two revolving conical trommels with 1/4" round perforations through a V-shaped hydraulic classifier and discharged into the mineral bins as No. 1 grade mineral (large pieces which averaged about 96% copper). The Tamarack classifier operated exactly the same as the separator mentioned in reference to the Portage Lake mill; the technology and changed little in forty years. The hydraulic mortar discharge and the two hydraulic separators before the trommels yielded about 50% of the total output of copper. A 12 in. bucket elevator carried the oversize from the trommels back to the mortar for restamping, although this system was soon replaced by one where the oversize was ground on a set of Triplex rolls. [H.A.E.R. Drawing "Diagram of Quincy Milling Procedure, c. 1900," shows the system after the installation of the rolls, which were original equipment in TL-2.] The undersize flowing through the 1/4" trommel was delivered to six, four spigot V-shaped hydraulic classifiers. Each spigot fed two 2 cell jigs.[108]

The first set of jigs was called the roughing jigs. These were basically the same Collom jigs used in the old mill. The sieves were eight and ten mesh. Finished material was removed from the sieves and placed on a conveyor which emptied into the mineral bin. Tailings went to the waste launder and were dumped into the lake. The middlings went on for further treatment.[109]

The middlings from the roughing jigs were first run through a hydraulic separator where the free material was removed. The remainder was fed into a three cell Hodge jig. The Hodge was larger than the Collum, but its operation was the same. These finishing jigs were equipped with 12- and 14- mesh screens (1.07 and 0.91 mm. openings) and operated at 172 rpm with 5/8" strokes.[110] Each jig produced a finished product, more middlings, and tailings. The middlings from the jigs were treated on Wilfley tables.[111]

The tailings from the roughing jigs went to a settling tank, where some of the excess water was removed. The slime was reground on a six-foot Trent Chilean mill. The mill consisted of an iron tub with a number of screened windows and two heavy rubber rollers mounted vertically on a central drive shaft. The mill product was also treated on a Wilfley.

It should have become obvious by now that the Wilfley table played an important role in the wash department of the Quincy mill. As early as 1901 the Quincy Company had begun to replace the Evans Buddles that were installed in TL-1 in 1890 with Wilfley tables. The original Wilfley table was made by Arthur R. Wilfley in 1896 and first used at his mill in Colorado. This machine revolutionized ore dressing and was a phenomenal success from the outset.[112]

The deck of the Wilfley table was made of redwood, overlaid with linoleum. A series of tapered riffles or groves, ending along a diagonal line, were placed on the linoleum surface, forming a riffled portion and a flat portion. The table was equipped with 46 riffles of varying length. Water and mineral flowed onto the table along the feed side toward the back end. The mineral settled out of the water behind the baffles. The larger particles settled first toward the top of the table, the smaller particles nearer the bottom. The deck of the table vibrated along its length about 240 times a minute. This vibration caused the material to slide toward the unriffled surface. Concentrated ore flowed off the unriffled surface and was collected. Middlings flowed off the center of the table bottom and usually went on for furthertreatment. Tailings were collected off the tailing end of the table and were sent to be dumped.[113]

The capacity of a Wilfley table varied from 10 to 40 tons per 24 hours, depending on the size of the feed. The smaller the sized feed reduced the capacity of the table. The quantity of wash water used varied from 5 to 20 gallons per minute, according to the quality and quantity of the feed.[114] The Wilfley table could be adjusted to separate copper particles of virtually any size. Thus, it could capture particles of mineral that had formerly been lost in the tailings. This table was one of the reasons why the output of the Quincy mills increased so rapidly.

The finished product was handled mechanically in both mills. The mineral bins and scales were all located at TL-1. The mineral from TL-2 was conveyed to mineral cars by means of a hand operated trolley system. The mineral cars, when loaded, were hauled to the mineral bins in TL-1 by an electric trolley locomotive and were weighed before they were dumped. All the mineral from TL-1 was conveyed to the mineral bins on the same type of hand trolley system that existed in TL-2.[115]

The two decades from 1900 to 1920 were to be the best years the Quincy mills would have throughout their almost eighty years of operation. Copper prices were generally good, ranging from a low of 11.9 cents per pound in 1902 to a high of 29.2 cents in 1917. Profits and dividends were also high, thanks in no small part to the excellent service provided by the Torch Lake complex. Mine output reached an all-time high and the period 1900-1920 undoubtedly marked the "Golden Age" of the Quincy Mining Company.[116]

There were few external changes made at the Torch Lake complex throughout the first decade of the twentieth century. In 1901 Quincy signed a contract with the American Bridge Company for the erection of a coal unloading and storage facility at Torch Lake. The plant consisted of three steel towers, each with an unloading capacity of 135 tons per hour, and a steel coal storage shed, 385' x 301', having a storage capacity of about 70,000 tons.[117] The coal facility was completed along with its attendant railroad facilities in 1902, and gave satisfactory service for many years afterwards.[118]

The old coal yard, constructed in 1899, had given good service, but the growing use of electrification at the mine and the increased demand for coal-generated steam had shown the facility was too small. Also, the local railroad companies were unable to handle the volume of coal Quincy wanted to ship from its dock to the mine. Therefore, Quincy built larger facilities and extended its own railroad to provide for its immediate coal needs.[119] The new dock looked very much like the 1889 facility, but was much larger. The new construction resulted in a gradual lowering of fuel costs and an increase in efficiency in coal unloading and transportation processes at the dock and at the mine.

The only other exterior change made before 1910 was the erection, in 1904, of a mineral house at the west end of TL-1. This structure contained six twenty-five ton capacity storage bins. These bins held the product of the stamp mill; from there the copper was loaded onto railroad cars for the trip to the smelter.[120]

Most of the improvements made at the Quincy Torch Lake complex were made in the field of milling technology. During the years 1905 - 1917 important changed in mill recovery techniques followed one another so rapidly that almost continuous renovations of plant facilities became necessary.[121] These changes were all aimed at improving copper recovery in the mill's wash department. In this respect the Quincy Mining Company no longer lagged behind other companies in the adoption of new technologies. Quincy was rarely an innovator, but it seldom took the company very long to adopt a new technology after it had been proven at another location.

The process shown in the H.A.E.R. drawing "Quincy Mining Company: Stamp Mill Flow-Chart, c. 1900" developed over the course of approximately five years, roughly 1900-1905. In 1901 the Quincy Company began to replace the Evans Buddles that were installed in TL-1 in 1890 with Wilfley tables. The original Wilfley was made in Colorado in 1896. Its construction and operation have been described elsewhere. This one machine revolutionized ore dressing and was a phenomenal success from the outset.

In 1902, a Trent Chilean mill was installed in TL-2 to treat the coarse sands from the roughing jigs. The mill consisted of an iron tub, six feet in diameter, with a screened window which allowed the ground material to flow from the tub.[123] These mills were so successful that the company decided to introduce similar mills at TL-1.[124] By 1903, most of these additions were complete, and the company was able report that the cost of milling had been reduced and that more copper was being saved in the tailings.[125] [See Table 5, below, for totals.]

Changes continued in 1904. TL-1 was equipped with an Allis-Chalmers six foot Huntington mill, essentially an improved version of the Chilean mill in use at TL-2. The stamp heads in TL-2 were "compounded" in 1904. This change involved using the exhaust steam from the head for another purpose, in this case to drive a low pressure turbine. Compounding was the name applied to the system of getting increased use out of the steam generated for another purpose. The turbine was used to generate the power necessary to light the mill and to power some of the mill's auxiliary machinery. The net result was more efficient use of the steam and a reduced drain on the coal pile.[126]

A number of other additions were made to the Torch Lake mills before the first decade of the twentieth century had expired. At TL-2, head No. 8, a set of Nordberg

TABLE 5
Operations of the Quincy Stamp Mills, 1893-1905

Year	I	II	III	IV	V
1893	422,239	1.393	$.269	11,765,040	$.359
1894	454,783	1.497	.235	13,623,085	.0078
1895	495,401	1.486	.228	14,670,530	.0077
1896	555,543	1.372	.216	15,251,410	.0079
1897	542,623	1.422	.225	15,429,725	.0079
1898	543,592	1.353	.222	14,712,685	.0082
1899	559,164	1.20	.220	13,439,205	.0092
1900-1	549,560	1.238	.239	13,611,060	.0096
-2	9,163	1.13	.395	207,770	.0174
1901-1	539,411	1.197	.264	12,915,690	.0110
-2	346,855	1.231	.272	8,541,595	.0110
1902-1	538,382	1.152	.230	12,408,125	.0100
-2	414,636	1.095	.210	9,085,475	.0096
1903-1	472,531	1.104	.216	10,433,165	.0098
-2	486,402	1.103	.190	10,726,620	.0086
1904-1	555,277	1.132	.203	12,578,020	.0090
-2	463,595	1.199	.202	11,125,135	.0084
1905-1	642,561	1.149	.191	14,758,389	.0083
-2	492,600	1.192	.197	11,747,979	.0083

KEY

I - Tons of Rock Stamped

II- Percent Copper Per Ton of Rock Stamped

III- Stamping Cost Per Ton of Rock Stamped

IV- Pounds of Copper Produced From Stamp Rock

V - Stamping Cost Per Pound of Copper Produced

Year-1 - Totals for Torch Lake 1

Year-2 - Totals for Torch Lake 2

Source: Qunicy Mining Company Cost Sheets for the years 1893-1905.

crushing rolls was installed to handle the oversize from the trommels. The two counter-rotating steel rolls crushed the pieces of rock against a fixed center roll. By this simple expedient, the output of this head was increased by over one hundred tons per day.[127] In 1906, the Nos. 6 and 7 heads also had rollers installed. The overall results of these rolls so impressed the company that it had similar rolls installed at the heads in TL-1.[129] These were installed in 1908-1909. To run the rolls, Quincy installed a 14" x 36" Corliss engine that had been removed from the No. 2 rockhouse.[130]

In the 1908 Annual Report, General Manager Charles L. Lawton had warned that TL-1 was due for major repairs.[131] This renovation work was performed in 1909. The major project involved replacing the stamp foundations. Quincy pushed its work force to complete the work; a job that normally took six weeks was completed in ten days.[132] In another experiment, one stamp head in TL-1 was equipped with two extra-large oversize jigs, four sets of Woodbury jigs, and one set of 12" x 36" x 60" Triplex rolls, together with the necessary finishing jigs, Wilfley tables, and vanners. The system remained in operation into the next decade.[133]

The Woodbury jig was an all metal machine manufactured by the National Ore Concentration Company. It was actually a three part system of jigs: a jig classifier, a clean up jig, and a middling jig. The process was essentially the same as used in the Hodge and Collom jibs earlier, but the machines were more compact and more mechanically efficient. The Woodbury system also had six times the capacity of the same number of Hodge and Collom jigs.[134]

The Frue vanner was a slow moving inclined belt that agitated from side to side. The agitation made the ore bed loose so minerals of higher specific gravity could settle to the lower layer while those of lighter weight could raise to the upper layer. The gravel of the belt carried the heavier material to the upper end, while the surface water washed the lighter material to the tailings end of the table.[135]

By 1910, the Quincy mills had reached a level of technological development that made them highly efficient and in almost all respects good examples of a well-equipped copper mill in the Lake Superior district. The days when Quincy had gained some notoriety because of its mill were long past.

Between 1910 and 1930, modifications made at the mill reflected the impact of a rapidly changing technology on the wash department of the mill. The seemingly endless litany of changes, some major and some minor, continued throughout the next two decades. Between 1910-1920, most of the changes involved the renovation of existing structures and their equipment. In the 1920's, the milling process underwent some drastic changes.

The major change in the milling process between 1910 and 1920 was the erection of a system of jigs, tables, and rollers or grinders to reduce all the oversize from the trommels and consequently to deliver a classified and finely crushed sand to the other washing machines in the mill. This construction was begun in 1912 and continued well past the middle of the decade as more units were added to both of the mill buildings.[136] The major addition involved the introduction of a 36" x 8' Hardinge ball mill to each mill. These machines crushed the tailings from the roughing jigs by abrading the particles through the tumbling action of specially made stone balls.[137]

Most of the work between 1913 and 1919 was done on structures, not on equipment, and what equipment was purchased was not directly related to the milling process. For example, in 1913 Quincy installed a 20,000,000 gallon capacity 18-inch, Class "B" Worthington Involute pump. This pump, of higher capacity than any of Quincy's other pumps, was installed as a reserve. The pump is also of interest because it was powered by a 500 H.P., 2,200 volt, 708 R.P.M. General Electric induction motor.[138] This seems to have been the first major piece of machinery at the mill to be powered by electricity.

The pumping and steam generating equipment seemed to have received more than its share of attention throughout the decade. The eight boilers in the TL-1 boiler house were replaced by four 400 horsepower Babcock and Wilcox Company

"Stirling" boilers. These boilers were built to carry 160 pounds of steam pressure. The old boilers could carry only 110 pounds of steam. As the electrification of the mine and its support facilities progressed, the demand cor coal expanded to the point where it became necessary to renovate the coal handling facilities to improve their operation. This was done in 1916.[139] In the same year a new 175' smokestack was erected at the No. 1 boilerhouse.[140] In 1917, Taylor mechanical stokers and ash handling equipment were installed in both of the boiler houses. These replaced the original stokers that had been installed when the facilities were built.[141] The improvements in the boiler and pump facilities and the increased demans of the five stamps in the No. 1 mill made it necessary for Quincy to install a new, larger (30") water line to the mill, as well as necessitating the repair and renovation of the adit.[142]

The capacity of the mineral bins in TL-1 was doubled in 1917, when the entire western end of the mill building was completely remodeled. An automatic sprinkler system was installed in every building at the complex in 1917.[143] This reflected Quincy's continuing concern with the fire hazard in its buildings. TL-2 was made of steel,: the building itself was essentially fireproof, although the wooden jigs and Wilfley tables were inflammable. TL-1 was of wooden construction and a more substantial fire risk. The sprinkler system included a 75,000 gallon water tank. The only major addition to the surface structures, the assay office, was erected in 1916.[144]

When the price of copper began to rise during World War I, the Quincy Mining Company unveiled plans for major additions to both of the mill buildings. The additions were "to provide room for a greater number of tables to more efficiently dress the original slimes, and to provide room for the installation of the ball mills for regrinding all the coarse tailings, and for the necessary tables to dress this material."[145]

The wartime shortage of steel made it necessary for the Quincy Company to use other materials for its new construction. The addition of TL-1 was constructed of reinforced concrete and brick. Its dimensions were 123' x 215'. The TL-2 addition was constructed of the same materials, although it was somewhat smaller (91' x 132'). Both additions were fireproof and featured broad expanses of glass to provide interior lighting.[146]

The apparent slowness of construction led to an acrimonious exchange of letters between William Rogers Todd and William Parsons Todd and mine general manager Charles L. Lawton. W. P. Todd was especially insistent that Lawton push the work on the structures,[148] and that every effort be made to increase the recovery of copper from the waste tailings.[148] Lawton, of course, replied that he was doing the best he could, faced as he was with the war-time shortage of labor and material.[149] W. R. Todd was still not satisfied. In June, 1919, he complained to Lawton:

> As you know, down here [New York City], construction companies can put up a twenty story building and have it occupied six months after the foundation is completed. The Government to do a similar job would take fully two years, and our construction operations remind the operator very much of Government building operations which drag along and never seem to progress with any reasonable dispatch.[150]

The Todds continued to press for the exact completion dates; Lawton invariably refused to be pinned down.[151]

The intra-company arguments notwithstanding, the mill additions were finished late in 1919. All the new equipment, including two Dorr classifiers, was in operation by March, 1920. Unfortunately, by this time, the copper boom of the early years of the twentieth century was spent. The new equipment was barely in operation before market conditions made it necessary to contract milling operations.

The 1920s saw the beginning of the gradual decline in the fortunes of the Quincy Mining Company. Rapidly falling copper prices made it increasingly unprofitable and costly to pull material out of the lower reaches of the Quincy property. The construction of the mill contributed to an expansion in mining operations; the cut-back in mine production and a concurrent stringent economy drive led to unavoidable cuts at the mill.

Torch Lake 2 was closed on January 4, 1921. The move was made to cut production costs. TL-2 was the better equipped of the two mills, but with only three heads, as opposed to TL-1's five, the choice of the mill to close was obvious. Unfortunately, the closing of TL-2 meant the company had to spend more money than it wanted to to get TL-1 up to the most efficient standards. Quincy took steps to insure that TL-2 stayed in shape to resume operations on short notice, although that notice never came. A high pressure steam line was run from the No. 1 boiler house to the number 2 mill. This provided heat to the building, and meant that the No. 2 boiler plant could be shut down.[152]

The most important change that occured at the Torch Lake complex beyond those directly related to the milling process was the introduction of electrical power. This was a step that had been planned for some time. In 1919 the company filled in a small ravine between the two mills to provide a site "for a low pressure steam turbine to utilize the exhaust steam from the stamp heads to furnish electric power to operate the ball mills, crushing rolls, etc."[153]

The question of how large a turbine to put into the new plant was the occasion of another conflict between Lawton and the Todds. Lawton believed that a 1,500 K.W. plant would be sufficient.[154] W. P. Todd favored a larger turbine: "In the past we have often made mistakes in putting in equipment of too small capacity, and partly for this reason we lean toward considering a 2,000 K. W. turbine."[155] Lawton continued to press for a 1,500 K.W. plant immediately, with the possibility of adding a second turbine of the same size later.[156] Lawton lost this argument; Quincy ordered a General Electric 2,000 K.W. turbine. Even in the choice of equipment, Lawton was subjected to pressure from the Todds: "Parsons tells me he mentioned to you our preference for General Electric installation, and we would like to have you keep this in mind and make a special effort to get these people to submit a favorable proposition."[157]

Once again, despite the confrontation, the turbine was built. In June, 1921, contracts were made with the General Electric Company for a 2,000 K.W. mixed pressure steam turbine, with 1,500 K.W. low pressure blading and 500 K.W. high pressure blading. This turbine represented the final step in the electrification of the Quincy mine, mill, and smelter complexes. The erection of a power generating facility had been considered for some time. Quincy had used the fact that it was considering building its own turbine as a lever to force the local power company to offer them lower rates. Prior to 1920, the power company had always done so. Eventually, however, it could go no lower and Quincy decided to build its own generating plant.[158]

The building constructed to house the turbine was made of steel reinforced concrete, faced with brick, two stories high, measuring 36' x 38' x 45'. The new plant was scheduled to begin operations in April, 1923; it opened on time, on April 16, 1923. Quincy began to save money almost immediately. The company supplied its own power needs for January, 1924, while using 640 tons of coal less than for January, 1923. Mill output and power requirements were approximately equal for both months.[159]

To take advantage of the new, cheaper source of electrical power, electric motors from the idle TL-2 were installed in TL-1 to replace the two Corliss engines that had previously powered the mill. A third electric motor was installed to power the crushing rolls. A power line was erected between the mill and the mine to provide power from the Torch Lake plant. By 1924, the cost of generating electrical power was about .3 of 1¢ per K.W..[160]

Since the No. 1 mill now had to assume responsibility for treating the entire output of the mine, the company made special efforts to keep the plant in good operating condition. In 1920, four of the five stamp heads had been equipped with a complete regrind installation consisting of a ball mill and 31 Deister "Plat-o-tables." The mills were March ball mills, and they were fed from a Dorr classifier. The ball mills ground the rough and finishing jig tailings together with the middlings from the slime and regrind tailings. Each unit also had eight Wilfley slime tables.[161] [The Deister was an improved Wilfley.] Work was also done on facilities to remove heavy copper from the material entering the roughing jigs. These improvements included duplex trommel screens plus improved launder jigs between the trommels and the roughing jigs.[162]

The last and perhaps the most revolutionary changes made in the milling process occurred between 1927 and 1930. In 1927, a research for the U. S. Bureau of Mines, A. W. Fahrenwald, discovered that free copper from amygdaloid was recoverable by the flotation process. Quincy immediately installed flotation machines at the mill, and quickly realized a savings of approximately three pounds of copper per tone of rock stamped.[163] The chemistry of the froth flotation system is far too complex to be examined in any great detail here, so only a brief description will be given.

Oil flotation consisted of the separation of finely divided mineral particles from the waste rock by violent agitation of the ore in a water medium containing oil or some other frothing agent plus chemicals selected for the particular ore desired. With the ore, water, oil, and chemicals properly proportioned, this agitation resulted in bubbles rising and constituting a froth which supported the mineral bearing particles. This froth was skimmed off as a concentrate, while the waste product sank to the bottom of the water chamber.[164]

In order to adopt the new technology, Quincy offered 40,000 shares of treasury stock at $12.50 per share and 50,000 shares of capital stock at $25.00 per share. After raising the necessary funds, the company installed three Fahrenwald oil flotation machines, each with a capacity of 1,000 tons daily. The machines became part of the equipment of the Nos. 1, 3, and 5 heads.[165]

At Quincy, the slimes from the various washing tables and ball mills were thickened in a 40' x 17' Dorr thickener tank that was installed adjacent to the main building in 1929. The thickened pulp was fed into the oil medium of the flotation machine, along with drafts of air. The copper particles attached themselves to the resulting bubbles. Each machine had twelve cells. The product of the first cell was sent to the second and third cells, and so on. The tailings from the flotation machine assayed to about 1½ pounds of copper per ton. This represented a savings of about 3 lbs. of mineral per ton of rock stamped.[166]

In 1930, new equipment was installed at the mill to "reduce the labor factor and increase the tenor of the mineral sent to the smelter. It also reduces the copper loses in tailings or waste sands."[167] The equipment consisted of one 3' x 18' Dorr classifier and 7 rubber top roughing tables. These replaced 6 Tamarack separators, 24 two compartment roughing jigs, and four three cell finishing jigs.[168]

A complete flotation unit was installed at the No. 2 head in 1930, the last addition made to the mill before it closed in 1931. This umit consisted of one 24" twelve cell flotation machine, one 3' x 18' Dorr classifier, one 12' x 7' Dorr concentrate thickener, and three reagent feeders.[169] This set-up was truly state-of-the-art. Unfortunately, it was in operation for only a short time when the Great Depression forced the closing of the Quincy Mine location.

* * * * *

In the space of seventy-seven years, the Quincy Mining Company went from a position where it had an obsolescent milling establishment to one where its mill was thoroughly modern and highly efficient. Pushed by falling copper prices and the desire to continue to pay regular dividends, the company was forced to adopt modern milling technology and quickly became one of the leaders in the adoption of new milling processes. The construction of a modern, efficient mill enabled the company to increase the production of its mining facilities and to maintain profits by compensating for lower prices with higher production. The old mill enabled the company to make substantial profits throughout the last half of the nineteenth century. The Torch Lake complex enabled the mine to live up to its nickname - "Old Reliable" - throughout the first third of the nineteenth century. The Quincy mills were the units that enabled the company to weather most of the variations in the business cycle and still maintain a favorable economic position. The Quincy mills were one of the most important factors in the success of the mining operation. Their efficiency helped to make possible the profits generated by the mine. The Quincy Mining Company had a valuable vein to work and the mills helped to make it a profitable one.

NOTES

[1]Robert B. Davidson to Chirstopher C. Douglass, December 19, 1854.

[2]For information on the early history of the Quincy Mining Company, see Charles DeWitt Lawton, A Review of Lake Superior Copper Mining and Sketch of the History and Operations of the Quincy Mining Company (New York: J. B. Myers Press, 1907), especially pp. 11-13. Also see companion H.A.E.R. Reports, especially Charles K. Hyde's report on the economic history of the Quincy Mining Company.

[3]Albert H. Fay, A Glossary of the Mining and Mineral Industry (Washington, D. C.: United States Government Printing Office, 1920), pp. 32-33.

[4]Material for the Introduction drawn primarily from Thomas H. Rickard, The Copper Mines of Lake Superior (New York: The Engineering and Mining Journal, 1905); and Thomas Egleston, "Copper Dressing in Lake Superior - I-IV," The Metallurgical Review, Vol. II, Nos. 3, 4, 5, 6.

[5]Quincy Mining Company, Annual Report for 1860, p. 9.

[6]Davidson to Douglass, March 16, 1852.

[7]Records of the Quincy Mining Company: Time Book, 1851-1855; Contract Book, 1856-1860; Returns of Labor, 1857-1864

[8]There is a dearth of information on the site, operation, and equipment of the Quincy stamp mill on Portage Lake. James Fisher, "Historical Sketch of the Lake Superior Copper District," Keeweenawan, 1924, p. 255 contains information on the location of the mill but is in error about its equipment. O. W. Robinson, "Recollection of Civil War Condition in the Copper Country," Michigan History Magazine, Vol. III, No. 4, October, 1919, p. 599 discusses the installation of the sand wheel in some detail, but makes no pretense of being a complete survey of any aspect of Quincy mining operations. The best source of information on the mill are the records of the Quincy Mining Company. See especially the Annual Reports for 1860-1869, Stamp Mill Account Book, 1860-1863, and Returns of Labor, 1857-1864.

[9]Q.M.C., Annual Report for 1862, p. 5.

[10]Q.M.C., Annual Report for 1863, p. 12; Samuel B. Harris, Agent, to Thomas F. Mason, President of the Quincy Mining Company, December 18, 1884.

[11]The tramway was kept in repair by the mine's

small force of carpenters and mechanics who provided regular maintenance throughout the year. Major overhauls, which involved the reconstruction of many of the wooden structures and the installation of new rails were performed in 1868 (costing $11,820.03), 1871 ($13,000), 1873 ($11,000) and 1889. The incline was covered with a snow shed in 1873. Maintenance costs for the tramway are included in the Quincy Mining Company Annual Reports for 1860-1892. For a more detailed record of specific labor costs incurred in maintaining the tramway see Q.M.C., Returns of Labor, Contract Books, and Invoice Books for the period. The Annual Reports up to 1870 also list labor costs and the amount of rock carried.

[12] Egleston, "Copper Dressing in Lake Superior - III," The Metallurgical Review, Vol. II, No. 5, July, 1878, p. 389.

[13] Q.M.C., Annual Report for 1862, p. 5.

[14] A. Snowden Piggot, The Chemistry and Metallurgy of Copper (Philadelphia: Lindsay and Blakiston, 1858), pp. 184-185; Antoine M. Gaudin, Principles of Mineral Dressing (New York: McGraw-Hill Book Co., Inc., 1939) pp. 43-45; Robert H. Richards, Ore Dressing, 4 vols. (New York: McGraw-Hill Book Co., Inc., 1908) pp. 144-145; Algernon DelMar, Stamp Milling (New York: McGraw-Hill Book Co., Inc., 1912), pp.1-3. Q.M.C., Invoice Book, 1860-1863.

[15] Gaudin, Mineral Dressing, pp. 44-45; John F. Blandy, "Stamp Mills on Lake Superior," Transactions of the American Institute of Mining Engineers, 1874, pp. 208-215.

[16] Egleston, "Copper Dressing - III," p. 389.

[17] Richards, Ore Dressing, p.387.

[18] Egleston, "Copper Dressing - III," p. 391.

[19] Ibid., p. 393; Richards, Ore Dressing, pp. 510-515.

[20] Richards, Ore Dressing, p. 1196.

[21] Fay, Glossary, pp. 435, 670-671.

[22] Q.M.C., Annual Report For 1863, p.13.

[23] Fay, Glossary, p. 623.

[24] Robinson, "Recollections," p. 599.

[25] Q.M.C., Annual Report for 1869, pp. 18-19; Annual Report for 1884, pp. 12-13.

[26] Q.M.C., Annual Report for 1882, p.13.

[27]Q.M.C., Annual Report for 1883, p. 13; Annual Report for 1884, pp. 12-13.

[28]Q.M.C., Annual Report for 1887, p. 12.

[29]Q.M.C., Annual Report for 1863, p. 13.

[30]Q.M.C., Annual Report for 1868, p. 22.

[31]Q.M.C., Annual Report for 1876, p. 15.

[32]Q.M.C., Annual Report for 1877, p. 21.

[33]Q.M.C., Annual Report for 1878, p. 4.

[34]Blandy, "Stamp Mills," p. 208.

[35]Gaudin, Mineral Dressing, p. 46.

[36]Richards, Ore Dressing, pp. 144-223.

[37]Q.M.C., Invoice Book, 1860-1863.

[38]William B. Gates, Jr., Michigan Copper and Boston Dollars (Cambridge, Mass.: Harvard University Press, 1951), pp. 26-27.

[39]Rickard, Copper Mines, p. 122; Richards, Ore Dressing, p. 113.

[40]Richards, Ore Dressing, pp. 113-139.

[41]Q.M.C., Annual Report for 1864, p. 13.

[42]Material for Table 3 compiled from the various Annual Reports of the companies for the years mentioned. These years were chosen because the comparative data was available. There is no special significance attached to any year.

[43]C. Harry Benedict, Red Metal: The Calumet and Hecla Story (Ann Arbor, Mich.: University of Michigan Press, 1952), pp. 163-164.

[44]Q.M.C., Annual Report for 1877, p.21.

[45]Q.M.C., Annual Report for 1881, p.13.

[46]Egleston, "Copper Dressing - II," p. 285.

[47]Table complied from information contained in Q.M.C., Annual Reports for 1861-1889. Information for 1860, 1890-1892 not available.

[48] Information on the labor force was compiled from a number of sources. For division of labor and ethnic make-up, see Q.M.C., Time Book, 1863-1869. For cost of labor see Q.M.C., Annual Reports, especially 1861-1877.

[49] Q.M.C., Returns of Labor, 1857-1864; Q.M.C., Invoice Book, 1879-1881.

[50] Harris to Mason, October 4, 1884.

[51] Harris to W. R. Todd, March 28, 1890.

[52] Harris to Mason, April 3, 1890.

[53] Mason to Harris, April 9, 1890.

[54] Harris to Mason, April 9, 1890.

[55] Mason to Harris, April 10, 1890.

[56] Harris to Mason, August 1, 1893.

[57] Q.M.C., Annual Report for 1893, pp. 14-15.

[58] Harris to Mason, October 4, 1884.

[59] Mason to Harris, January 14, 19, 30, 1885.

[60] W. R. Todd to Harris, February 6, 1885.

[61] Mason to Harris, May 14, 1886.

[62] See "Map of the Quincy Mine Location and Vicinity, 1898," Q.M.C..

[63] Mason to Harris, May 16, 1887.

[64] Mason to Harris, May 23, 1887.

[65] Mason to Harris, June 13, 1887.

[66] H. C. Southworth, "Report on the Mill-Sites and Railroad Connections for the Quincy Mine," n.d., transmitted Harris to Mason, October 1, 1887.

[67] Mason to Harris, August 3, 1887.

[68] Benedict, Lake Superior Milling Practice, p. 25.

[69] Houghton, Michigan, Portage Lake Mining Gazette, September 19, 1899.

[70] Mason to Harris, April 5, 1888.

[71]Mason to Harris, September 20, 1889.

[72]Q.M.C., Annual Report for 1888, pp. 12-13.

[73]Q.M.C., Annual Report for 1889, pp. 11-12.

[74]See Charles F. O'Connell, Jr., "A History of the Quincy and Torch Lake Railroad Company, 1888-1927," H.A.E.R. Report, 1978.

[75]Typescript, "Quincy Mill," Houghton, Michigan, Portage Lake Mining Gazette, October 24, 1889, pp. 1-2.

[76]*Ibid*., p. 3; Q.M.C., Annual Report for 1888, p. 13; Mason to Harris, December 26, 1888; Edward P. Allis to Harris, July 6, 1889; Harris to Mason, April 3, 11, 1890.

[77]Q.M.C., Annual Report for 1888, p. 13; "Quincy Mill," p. 3.

[78]"Quincy Mill," p. 4.

[79]*Ibid*., pp. 2-3.

[80]*Ibid*., p. 3.

[81]*Ibid*., pp. 1-2.

[82]An excellent example of the interaction between New York, Michigan, and various suppliers can be seen in the exchange of letters that accompanied the decision to obtain a small hoisting engine. See letters from Mason to Harris, Harris to Mason, and Harris to Eagle Iron Works, M. C. Bullock & Co., Iron Bay Manufacturing Company, *etc*., August, 1889.

[83]Mason to Harris, January 4, 1889.

[84]Q.M.C., Journal, 1891-1894; Journal, 1887-1890; Ledger, 1888-1891.

[85]Q.M.C., Annual Report for 1898, p. 11.

[86]Harris to Mason, March 19, 1890.

[87]An examination of the voluminous correspondence between Harris and the New York office reveals few references to problems with or the operation of the mill. Mason made several trips to Michigan throughout the period and undoubtedly any problems were discussed at these times. For some reason the detail that normally pervaded the correspondence is lacking between 1890 and 1892.

[88]Q.M.C., Annual Report for 1890, p. 12.

[89]Q.M.C., Annual Report for 1891, p 13.

[90]Ibid.

[91]Q.M.C., Annual Report for 1893, p. 15.

[92]Q.M.C., Annual Report for 1888, p. 9; Annual Report for 1893, p. 10; Annual Report for 1899, p.9.

[93]Mason to Harris, April 24, 1894.

[94]Mason to Harris, April 17, 1894; Harris to Mason, August 3, 1898.

[95]Harris to W. P. Todd, December 28, 1898. The contract was signed on December 22, 1898. There appears to be no information available on who built the pump and boiler houses.

[96]Quincy building decisions are discussed in great detail in the company correspondence, and the reader should refer to the above citations for more general information.

[97]Horace J, Stevens, The Copper Handbook, Vol. 5, 1905 (Houghton, Michigan: Horace J. Stevens, 1905), p. 678.

[98]Q.M.C., Annual Report for 1900, p. 12.

[99]Stevens, Copper Handbook, Vol. I, 1900, p. 225.

[100]Q.M.C., Annual Report for 1898, p. 12; Annual Reportfor 1899, p. 13. There is no clear evidence to suggest why Allis was chosen over Worthington, although Harris was unhappy with the delays that had occurred in the construction of the 10,000,000 Worthington pump.

[101]Q.M.C., Journal, 1898-1901; Journal, 1901-1903.

[102]Q.M.C., Annual Report for 1900, p. 12.

[103]Harris to W. Hart Smith, February 18, 1893.

[104]H. G. Wright, "The Quincy Amygdaloid Mills," The Engineering and Mining Journal, July 22, 1911, p. 166; Rickard, The Copper Mines of Lake Superior, pp. 122, 129.

[105]Wright, "The Quincy Amygdaloid Mills," p. 166.

[106]Ibid.

[107]Ibid., pp. 166-167.

[108]Ibid., p. 167.

[109]*Ibid.*

[110]*Ibid.*

[111]*Ibid.*

[112]Richards, *Ore Dressing*, Vol. III, p. 1212.

[113]*Ibid.*, pp. 1465-1471.

[114]*Ibid.*, p. 1469.

[115]Q.M.C., *Cost Sheets* for the years 1893-1895.

[116]Wright, "Quincy Amygdaloid Mills," p. 168.

[117]Q.M.C., *Annual Report* for 1901, p. 12.

[118]Q.M.C., *Annual Report* for 1902, p. 13.

[119]For more information on the coal dock and the coal handling facilities in general, see O'Connell, "History of the Q&TLRR Company, 1888-1927."

[120]Q.M.C., *Annual Report* for 1904, p. 13.

[121]Gates, Michigan Copper and Boston Dollars, pp. 126-127.

[122]Richards, *Ore Dressing*, p. 1212.

[123]Gaudin, *Principles of Mineral Dressing*, p. 92.

[124]Q.M.C., *Annual Report* for 1902, p. 13.

[125]Q.M.C., *Annual Report* for 1903, p. 13.

[126]Q.M.C., *Annual Report* for 1905, p. 12; F. H. Abbot, "Preliminary Report on Compounding Stamp Heads at No. 1 Mill,"October 28, 1912, Quincy Mining Company.

[127]Q.M.C., *Annual Report* for 1905, p. 12.

[128]Q.M.C., *Annual Report* for 1906, p. 17.

[129]Q.M.C., *Annual Report* for 1907, p. 15.

[130]Q.M.C., *Annual Report* for 1908, p. 13.

[131]*Ibid.*

[132]Q.M.C., *Annual Report* for 1909, pp. 17-18.

[133]Q.M.C., Annual Report for 1909, pp. 18-19.

[134]Richards, Ore Dressing, pp. 1447-1448.

[135]Ibid., pp. 644-645.

[136]Q.M.C., Annual Report for 1912, p. 21.

[137]Q.M.C., Annual Report for 1915, p. 15.

[138]Q.M.C., Annual Report for 1918, pp. 17-18.

[139]Q.M.C., Annual Report for 1916, p. 16.

[140]Ibid., p. 17.

[141]Q.M.C., Annual Report for 1917, p. 18.

[142]Ibid., p. 19.

[143]Ibid., pp. 18-19.

[144]Q.M.C., Annual Report for 1916, p. 16.

[145]Q.M.C., Annual Report for 1918, p. 18.

[146]Ibid., p. 17.

[147]W. P. Todd to Lawton, June 17, 1919.

[148]W. R. Todd to Lawton, February 18, 1919.

[149]Lawton to W. P. Todd, February 20, 1919; Lawton to W. R. Todd, February 21, 1919; Lawton to W. P. Todd, May 29, 1919; Lawton to W. P. Todd, June 20, 1919.

[150]W. R. Todd to Lawton, June 17, 1919.

[151]Lawton to W. R. Todd, November 3, 1919.

[152]Q.M.C., Annual Report for 1921, p. 16; Annual Report for 1923, p. 16.

[153]Q.M.C., Annual Report for 1919, p. 16.

[154]Lawton to W. P. Todd, August 18, 1919.

[155]W. P. Todd to Lawton, November 8, 1919.

[156]Lawton to W. P. Todd, November 17, 1919.

[157]W. R. Todd to Lawton, June 9, 1919.

[158] Q.M.C., Annual Report for 1922, pp. 15-16.

[159] Ibid.; Annual Report for 1923, p. 15.

[160] Q.M.C., Annual Report for 1923, pp. 15-16; Annual Report for 1924, pp. 13-14.

[161] Q.M.C. Annual Report for 1920, p. 16.

[162] Ibid., pp. 15-16.

[163] Q.M.C., Annual Report for 1928, p. 7.

[164] Benedict, Red Metal, pp. 176-177.

[165] Q.M.C., Annual Report for 1928, pp. 7, 13-14.

[166] Q.M.C., Annual Report for 1928, pp. 13-14; Annual Report for 1929, p. 13.

[167] Q.M.C., Annual Report for 1930, p. 14.

[168] Ibid.

[169] Ibid., pp. 14-15.

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A History of the Quincy and Torch Lake Railroad Company
1888 - 1927

by

Charles F. O'Connell, Jr.

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In 1887 the Quincy Mining Company decided to erect a new stamp mill on the shores of Torch Lake, roughly six miles east of the mine location.[1] At the same time, the company also decided to build a railroad to connect the mine and the mill. Railroad construction began in 1888, and in 1890, when the new mill opened, the Quincy and Torch Lake Railroad was ready to begin hauling stamp rock from the mine to the mill. This task was vitally important to the operations of the Quincy Mining Company and occupied the railroad until 1931 and beyond. The Quincy and Torch Lake Railroad was a small narrow gauge line whose significance to the Quincy Mining Company far exceeded the financial value of the investment the company made for its construction. The railroad provided the cheap, reliable transportation the mining company needed to help insure the continuing profitability of its mine, mill, and smelter.

Although the Quincy Mining Company was forced to relocate its mill because its original mill had run out of room to dispose of its waste tailings, the company was under no compulsion to build a railroad. The Keeweenaw Peninsula, and especially the area around Hancock and Houghton, was well served by a number of small, local lines which ultimately made connections with the standard gauge roads that had reached Houghton in the 1880's.

In 1873, the Mineral Range Rialroad, organized by businessmen at Hancock, connected Hancock and Calumet. The MRRR operations also extended to Lake Linden and Gay. The Hancock and Calumet Railroad, developed by the owners of the Tamarack and Osceola mines, began operations in 1885. In 1885, under inducement from the Marquette, Houghton, and Ontonagon Railroad, a third rail for standard gauge operation was added to sections of the Mineral Range line. In the same year the Hancock and Calumet built a three foot gauge line along the Portage Lake shoreline into the Torch Lake area. The Mineral Range also built a branch line from Franklin Junction to the Quincy location, a distance of approximately two miles. In 1886, the area north of Portage Lake was linked with the rest of the Upper Peninsula by the construction of a railroad bridge between Houghton and Hancock. The first train passed over the Portage Lake Bridge on March 22, 1886, although the bridge was not ready for regular traffic until early April.[2]

Since the Hancock and Calumet line already connected the Quincy Mine with Torch Lake, the Quincy Mining Company sought some arrangement with that company and with the Mineral Range Railroad to transport its stamp rock to the new mill. However, Quincy also made preliminary plans to choose a route for its own railroad in January, 1888. Thomas F. Mason, the company president, did not believe that it would be wise or even necessary to build a private railroad, but he wanted "to show the R.R. officials that we don't rely on them entirely," and hoped thereby to induce them to lower their rates to secure Quincy's business, which promised to be considerable.[3] The railroad companies were not impressed by the threat of a Quincy-run railroad, and their intransigence on the rate issue led Quincy to continue work on its own line. Mason began to grow more enthusiastic about the possibilities of a Quincy railroad and suggested that the line would enable the company to shift its base of supply from Portage to Torch Lake and to end its dependence on the local lines for the movement of its supplies. The company's engineers, L. G. Emerson and H. G. Southworth, began laying out a route for the railroad in the spring of 1888.[4]

The local railroads did not believe that Quincy would be willing to spend the $100,000 it would cost to build and equip a railroad from the mine to the mill. The Mineral Range Railroad maintained that it had to charge Quincy at least 25¢ per ton for a long term agreement, assuming shipments of at least 400 tons per day. The railroad claimed that the extra Quincy business would initially cost it between $15,000 and $20,000, primarily for a new locomotive and cars. The Hancock and Calumet offered a price of 9¢ per ton, but it stipulated that Quincy would have to construct its own track at Torch Lake and furnish the railroad with forty rock cars and two locomotives. Quincy would keep the cars and sell the locomotives to the railroad on an installment basis. Agent S. B. Harris of the Quincy estimated that, counting the investment for new equipment, this arrangement would actually cost the company about 18½¢ per ton. He believed that Quincy could haul its own stamp rock for about 15¢ per ton. Quincy saw sound economic reasons for building its own railroad.[5]

There were, however, other, less tangible reasons that led to the decision to construct the Quincy and Torch Lake Railroad. The Quincy company had engaged in a long running conflict with the Mineral Range Railroad over right-of-ways, freight rates, and freight handling practices. This clash began as early as 1872, when the railroad sought to run a line through the Quincy wood yard on Portage Lake. Quincy refused to grant the easement, claiming, and not without good reason, that it would greatly "inconvenience" the operations of the yard.[6] The Mineral Range sought another right-of-way across Quincy property in 1886. The outcome of this attempt is unclear, but it generated more ill-will between the two companies. Agent Harris wrote:

> The part these gentlemen have played in this matter may appear to them to be very sharp and skillful (any villian can be that), but I look upon such action as treacherous and despicably mean. I have no faith in them and nothing but contempt for the whole gang.[7]

By 1888, when the Quincy railroad question was being decided, relations between the two companies had not noticably improved, and the rates the Mineral Range suggested did nothing to assuage the damages of the last decade's squabbles.[8]

The lure of the railroad also played a role in the decision to build a line. Harris especially seemed to be enamored with the prospect of a Quincy-owned and Quincy-run railroad. While stressing the economic advantages and the desirability of being "independant [sic.] of such a party as now controls the Mineral Range Railroad Co.," he also claimed that the possibility of running a railroad "is a gloriuos thing."[9] The ultimate decision to build the railroad was based primarily on hard economic factors, but it is clear that company pride also influenced the decision.[10]

L. G. Emerson and H. C. Southworth finished a preliminary survey in early June, 1888. The route they had chosen was six miles long through broken country. The first mile east of the mine was nearly level, but there was a drop of some 400 feet to be covered in the last five miles. This necessitated a grade of 80 feet to the mile, not excessively steep and acceptable to the company. Despite this activity, the company had still not definitely decided to build a road. As the 1888 construction season approached, however, the management knew that the time for a final decision was at hand.[11]

Even before the actual decision to proceed was made, the Quincy and Torch Lake Railroad Company was organiized under the laws of the state of Michigan on June 27, 1888. Its charter was to run for thirty years; the officers of the company were Thomas F. Mason, President and Chairman of the Board; S. B. Harris, Vice-President and Vice-Chairman of the Board; D. Kloeckner, Secretary-Treasurer ; L. G. Emerson, Chief Engineer; and H. C. Southworth, Assistant Engineer. The railroad company was capitalized for $50,000, divided among five hundred $100 shares. Four hundred ninety-four of the shares were owned by Mason. Harris, Kloeckner, J. Cliff, J. Ross, G. S. North, and T. B. Dunstan held one share each.[12] One of the first actions of the directores of the Q&TLRR Co. was to issue $100,000 in 6%, 15 year term bonds. This infusion of funds was to be used to finance the construction of the Q&TLRR.[13] Since the existing railroads refused to give Quincy the rates that it sought, the company took steps to prepare the way for the construction of its own road.

The actual decision to build the Quincy and Torch Lake Railroad was made in early July, 1888. The suggested arrangements with both the Mineral Range and the Hancock and Calumet lines were unsatisfactory, so on July 5, 1888, Mason informed Harris that the company "had no alternative but to go on and build our road."[14] Harris immediately secured estimates and information and by July 21 was able to report that the new road would cost in the neighborhood of $120,000. The line was to have sixty pound rails (meaning they weighed 60# per yard) which would cost $31 per ton, f.o.b. Cleveland or Chicago. Harris also recommended that the railroad purchase two locomotives and 25 rock cars.[15]

Work began almost at once on the property that Quincy owned, but it was still necessary to secure rights-of-way from a number of parties that owned land along the proposed route of the railroad. The Dollar Bay Land and Improvement Company, the Highland Copper Mining Company, and James H. Seager, a private land owner, all received letters asking them to grant "free right-of-way," citing how "this railroad will enhance the value of your property in that vicinity." Arrangements were quickly concluded with these parties.[16] However, Quincy had considerably more trouble gaining the access it sought from its neighbors, the Pewabic and Franklin Mining companies.

Harris first wrote to Johnson Vivian, the captain at both the Franklin and Pewabic mines, using the argument that the new railroad would be of great use and value to these companies. Vivian refused to act, so Harris then wrote to D. C. Demmon, Secretary of the Franklin and Pewabic Mining companies. Demmon flatly refused to grant Quincy the necessary land.[17] This refusal marked the beginning of a bitter court case that was to drag on for seven months.

The refusal of the Franklin and Pewabic companies to cede rights-of-ways to the Quincy seems to have been rooted in a struggle for control of these companies that was being waged in New York and Boston. Franklin and Pewabic had both fallen on hard times, and both mines were in danger of closing. Quincy hoped to obtain the land of these two companies, since it wanted to expand its mining operations. The management of the Franklin and Pewabic companies was trying to resist Mason's moves toward obtaining control of their companies, and were naturally not disposed to grant their neighbor and enemy any concessions. Eventually Quincy triumphed on all fronts: the right-of-way lawsuit was decided in its favor in 1889; all the Pewabic lands were purchased in 1891; and the Franklin lands obtained in 1908.[18]

Quincy instituted condemnation proceedings against the Franklin and Pewabic lands in 1888. Its argument was specious at best, especially in light of the later operations of the Q&TLRR, although its arguments were used by other railroads in similar circumstances. Quincy maintained that its railroad was a public carrier and therefore the lands should be condemned for public use. This argument seems to have been contrived especially for the case, since there is no evidence that the railroad ever intended to haul anything more than its own coal and stamp rock. The decision to incorporate as a separate railroad company and not just to operate as part of the Quincy Mining Company seems to have been made in expectation of future legal problems. Interestingly, Quincy absolutely refuted the arguments it used in this case in 1925, when it sought to have its tax assessment reduced.[19]

Quincy spared no expense or effort in arguing its case. When a local judge refused to hear the case on a legal technicality, Quincy appealed to the Michigan Supreme Court. To present its case, Quincy hired Alfred Russell, a lawyer for the Wabash and Western Railway Company who had experience in similar cases. His services were expensive (roughly $1,500 for one month's work) but effective:

the case was ordered to be tried by the Houghton County Circuit Court.[20] The defendants could choose between a jury trial or a trial before a specially empaneled Board of Commissioners. Mason warned Harris to cover all possible contingencies:

> If the matter is to be decided by Commissioners try and have the right men suggested to the judge, mining men if possible and not village traders - but of course all that will occur to you and Mr. Chadbourne [one of Quincy's lawyers]. Perhaps also if the sherrif can be a little particular in selecting jurors, trying to get all from the east part of the county [if] it would be more favorable. Mr. Todd suggests that a hint from Geo. North [a Houghton County politician, Q&TLRR shareholder, and operator of the Quincy company store] to him might cause him to be careful in that direction.[21]

The expensive and extensive preparations again proved to be worthwhile: the jury found in favor of the Quincy Mining Company on May 22, 1889, eliciting a joyous "Three cheers for ourselves" from Harris.[22] Quincy was ordered to pay the Franklin Mining Company $66.30 for a small parcel of its property and also to give the Pewabic Mining Company $6,178.20 for a much larger strip across virtually its whole lot.[23]

While the land acquisition case made its way through the courts, work had already begun on other sections of the railroad route. As the land was in the process of being graded, Harris sought to decide the question of whether to build a standard 4' 8" or a narrow 3' gauge road. Harris, citing the rapid growth of railroads in other parts of the country, suggested that Quincy should build a standard gauge railroad.[24] This choice became more likely when the Duluth, South Shore and Atlantic Railroad, a standard gauge line, expressed an interest in making connections with the Q&TLRR and extending its line to Calumet. Harris favored this approach, but delayed making any decision without consulting Mason, who was to visit the mine during the fall of 1888. During his visit Mason was to meet with representatives of the DSS&A to perhaps complete the arrangements.[25] Harris in the meantime chose a safe route by ordering standard gauge (8 ft.) railroad ties. These would accommodate either narrow or standard gauge, or allow the company to install a third rail, which meant that the same line could be used for either narrow or standard gauge operations.[26]

Unfortunately, the anticipated meeting between Mason and the DSS&A representatives never took place. Harris still favored standard gauge, but, in the absence of any overtures from the DSS&A, suggested that a narrow gauge line was preferable, since easy connections could be made with both the Mineral Range and the Hancock and Calumet lines. For this reason, the Q&TLRR laid a narrow gauge line, although some sections of the track were later converted to third-rail use.[27]

Once all the key planning decisions had been made the company turned its attention to the construction of its six miles of track and to obtaining the necessary rolling stock. Work on clearing the right-of-way began in August, 1888. Bids for the general clearing and grading were received from late July until August 4, when the bids were opened.[28] The contract for building the Q&TLRR was awarded to R. M. Hoar, although the amount of his bid is not known.[29] Between July 31, 1889 and October 31, 1890, the contractor received $56,108.72. Most of the entries in the railroad's books show that payments were made to "Hoar and Mason." Nowhere is this "Mason" identified, but it is probable that Thomas F. Mason or one of his relatives may have provided Hoar with some of the capital that he needed to initiate the construction of the road.[30]

Track laying began in April 1889, and was largely completed by the end of the same year. The road bed consisted of a single track of 60 pound rail, laid on 8 foot ties. The track ran from a small engine house at the south end of the mine, also constructed in 1889 at a cost of roughly $5,000, to the trestles at the rear end of the Torch Lake mill. The total cost of construction, including surveying, right-of-way, clearing, bridges, track laying, rails, and ties, was approximately $93,200.[31]

The only surface structures built for the railroad were the round house, a stone building 60' x 38', a water tank at the mine end of the line, and a second tank at the mill end. The mill tank was fed by a small stream that ran behind the mill, and was not equipped with any pumps or auxiliary supply sources. There were two Detroit Bridge Company 50' iron turntables, one just outside the roundhouse and one near the water tank just behind the mill.[32]

The Q&TLRR began operations with a modest amount of rolling stock. The initial order for cars was placed with the Wells, French and Company of Chicago in early August, 1889. This order included thirty rock cars, $375 each, and three 30' flat cars, $300 each. The flat cars were received first, and were used in the construction of the road. The Peninsular Car Company supplied a small four wheel caboose, which cost $250.[33]

Two steam locomotives originally provided power for the Q&TLRR. The order for Q&TLRR #1, christened the "Thomas F. Mason," was placed in the fall of 1888, and the Brooks Locomotive Works of Dunkirk, New York delivered the engine in June, 1889. It was a 32 ton mogul, 2-6-0, equipped with 15" x 20" cylinders and 42" drivers. Q&TLRR #2 was a duplicate of #1, built in November, 1889 and delivered late that month. No. 2 was to be named the "S. B. Harris," but Harris vetoed the idea and suggested that it be named the "Thomas F. Mason #2." It appears that this name never stuck, probably to avoid confusion with No. 1. Each engine, with its attached tender, cost approximately $7,800, and they served the company for many years. No. 2 was taken out of service in 1911 and scrapped in 1915; for some reason it could not withstand the demands placed on it by the company. No. 1 served throughout the history of the line. It was on hand at the opening and made the last run on September 1, 1945, when the Quincy mine was shut down for the last time.[34]

The decade of the 1890's was, by virtually any standard, the "golden age" of the Quincy Mining Company. After the acquisition of the Pewabic lands in 1891 the company began a period of dramatic growth that saw its production figures and profits skyrocket. The Quincy and Torch Lake Railroad also benefitted from this growth, although its expansion occurred more toward the end of the period, especially between 1898 and 1903. The company's plan was to erect more mine surface structures and open new shafts and then expand the railroad to meet the new need. Because the railroad could be expanded more quickly than any of the other major surface components this policy enabled the company to spread some of its majou construction expenses over a longer period of time.

The history of the railroad is intertwined with the history of the company. Despite Quincy's protestations to the contrary in the court case, the road never made any serious effort to expand its business beyond the needs of the mining company. For this reason the ultimate success of the railroad was predicated upon the success of the mine.

Regular operations on the Quincy and Torch Lake Railroad began on March 20, 1890. In that month the line carried 2,366 tons of stamp rock to the mill. This figure reached 10,220 tons in April, when 668 cars were moved. Operations continued to expand throughout the year, and by December the railroad's two engines were moving 1,267 cars, roughly 42 per day, from the mine to the mill. In that month 20,906 tons were shipped. The December total amounted to roughly 16% of the year's product of 118,668 tons, for which the railroad received $19,915.20 from the Quincy Mining Company. Operating expenses amounted to $7,954.66, so for its first year of operations the railroad showed a net profit of $11,960.54.[35]

The railroad ran primarily on coal; for the nine months of its operation in 1890 it used 258 tons, plus 35 cords of wood, which may have been used in the railroad structures' wood-burning stoves. The railroad appears to have had five employees: A. W. Lord, engineer; Christopher W. Matson, fireman; John C. Carney, conductor; Martin Fleming, brakeman; and William N. Jakin [?], engine wiper. There are no records that list maintenance or service employees, although there must have been a small force available to repair the right-of-way and equipment. In April, 1890, Louis Lanouette was hired as "boss," although his job title was later changed to overseer and yard master. Pay rates were the same as those paid to similarily skilled mine employees - Lord received $75 for a 26 day month, Lanouette $60, Matson, $45, and the others all $40. These rates appear to have been considered adequate by railroad employees, since there is no record of labor trouble ever delaying railroad, although the railroad was of course responsive to work stoppages at the mine or mill. If the mine was closed there was no rock to transport to the mill.[36]

The only construction project undertaken by the railroad in 1890 was the addition of a six mile telephone line that ran between the mine and the mill. The line cost approximately $650, and required 115 man-days to complete. Beyond this essential but minor construction project, there were few additions to the surface structures of the railroad.[37] However, there was a two year period of major track construction after 1891 as the railroad facilities were expanded to include the Pewabic expansion. Between 1891 and 1893 the railroad spent about $600,000 on planning and building the complex of yards, switches, and mainline extensions that were needed to fully integrate the Pewabic property into the Quincy system. The line ran to any surface structure that used coal, or would have some reason to ship or receive large shipments of any kind. This would include the blacksmith shop and machine shops, as well as the various mine boiler facilities. Each of the shaft houses was served by the railroad. Material was hauled on several different kinds of cars, ranging from flat cars to the rock cars which were the most numerous.

These rock cars were bottom-dump hopper cars that hauled both coal and stamp rock. They were loaded from large bins at the rock houses and at the coal handling facilities. Most of the buildings served by the railroad had some form of a trestle over a bin or a receiving yard, where the cars were dumped.[38]

As a result of the Pewabic take-over and also because of the increased production of the Quincy property, the railroad found itself called upon to handle ever-increasing quantities of stamp rock. The following table illustrates this trend:

TABLE 1
Q&TLRR Operations, 1891 -1894[39]

Year	Cars	Tons Stamp Rock	Coal Used
1891	15,897	263,478	499 tons
1892	N/A	323,051	370
1893	24,837	422,239	903
1894	26,752	456,783	995

To handle this increased traffic, the railroad added more rock cars, and, later, another engine. In 1892 the company purchased twenty new rock cars from the Wells, French and Company, an expenditure of $9,000. In 1894 the Q&TLRR added locomotive #3, another Brooks Locomotive Works 2-6-0, although this one was somewhat larger than its stablemates, weighing 45 tons and mounting 44" drivers and 17" x 22" cylinders. This locomotive remained in service until the end of operations in 1945. It cost $8,204.60, came equipped with a $139.21 snow plow, and cost $516.00 to ship from Dunkirk to Hancock.[40]

To house the new engine, an additional stall was added to the roundhouse in the last quarter of 1894, at a cost of approximately $2,500.[41] The other major construction project undertaken in 1894 was the installation of a new switch at the number two shaft. This generated a period of short, extensive, and expensive work; the construction of the switch cost almost $3,500 and took place in October and November, 1894.[42]

All this increased activity meant an increase in railroad employment. The line employed twenty-four men in November, 1892, including two engineers, firemen, brakemen, and conductors and one full time car repairer, an engine wiper and a yard master. Employment in 1893 peaked in June at 41; most of the additional men were used for ballasting and grading the Pewabic extension. The work force stabilized at approximately 40 men throughout the last half of 1893 and through 1894. The men who were used for ballasting and grading in the summer and fall turned their shovels to snow removal in the winter and spring. For example, in June 1893, 481 man-days were used for ballasting and grading; in December 480 man-days were expended for snow removal. Throughout the rest of the decade the labor force reflected the policy of hiring men for snow removal in the winter months. However, as plows were added to more engines and as specialized snow plow cars were acquired the labor force became more stable, levelling off at about twenty men between 1896 and 1899. The winter labor force usually reached 40 men, as in 1895 and 1897.[43]

There was considerable construction work done on the Quincy and Torch Lake Railroad in the last half of the 1890's, and this construction continued into the early years of the twentieth century. This construction was undertaken in response to the steady growth of traffic on the road. Railroad operations continued to expand throughout the period, albeit more slowly than during the first half of the decade:

TABLE 2
Q&TLRR Operations, 1895-1899[44]

Year	Cars	Tons Stamp Rock	Coal Used
1895	27,014[1]	495,401	1,162 tons
1896	29,190[2]	510,000	1,125
1897	31,916	542,623	1,107
1898	31,945	544,762	1,156
1899	32,892	561,105	1,340

[1] 11 months. December total not available.
[2] 11 months. March totals not available.

The bulk of the construction occurred at the two ends of the line. The Quincy Mining Company built a second mill at Torch Lake and replaced the coal handling facilities that had been erected at the Torch Lake Complex in 1888. These changes necessitated the construction of much new track and many new facilities at both the mine and mill locations. The major additions were the new trestles at the mill (erected at a cost of approximately $6,000) and the coal handling facilities (the cost of the new track and trestles was about $46,000).[45]

The mill extension included the construction of about 1,300 feet of track from behind the first mill to the second, and also the erection of a 122 foot steel bridge over North Creek between the two buildings. The company also replaced about 280' of the old wooden trestle at the older mill building with a new steel one.[46]

By the time this project was completed Quincy was prepared to embark on a major new project to modernize and enlarge its coal handling facilities. The old coal yard, constructed in 1888, had given good service, but the increased demand for coal generated steam had shown that the old facility was too small. Also, the Hancock and Calumet and Mineral Range, now consolidated as part of the Duluth, South Shore and Atlantic system, proved unable to handle the volume of coal Quincy wanted to ship from the dock to the mine. Quincy had used the two local lines from the beginning because they had lines that ran along the Torch Lake shoreline and served the Quincy mine location, but now their apparent unwillingness to provide the services Quincy wanted and their high rates led Quincy to consider running a line down from behind the mill to the coal dock. Thus, the construction of the new coal handling facilities not only involved the coal facilities themselves but also the extension of the railroad.[47]

The equipment that Quincy adopted for its new facility reflected the state-of-the-art in coal handling technology. The plant was ordered from the John A, Mead Company of New York on January 17, 1902. The dominating feature of the coal dock was the coal storage shed. The building was 201 feet wide, 385 feet long, and about 40 feet high, and had a capacity of 66,500 tons of coal, which was stored in piles roughly 30 feet high. The unloading facilities consisted of three steel framed towers and three 2 ton automatic cars. The towers were set on rails 22 feet apart and were mounted on 12 double flange wheels run on standard railroad type T-rails on the dock. Each tower was equipped with a 14" x 24" cylinder double drum direct acting hoisting machine and a 10" x 12" double cylinder trolley engine for locomotion. These engines were connected to a high pressure steam boiler by flexible couplings, designed so as to provide limited mobility for each tower. This was the same type of system that was installed at the original coal dock, but the new one was much larger.[49]

A one gross ton capacity Rawson clam shell bucket did the actual unloading. Each tower had one bucket. These buckets were guaranteed to have a capacity of three trips per minute, and the average weight of coal lifted per trip was abot 1500 pounds as long as sufficient coal was within reach of the bucket. When coal got down to levels too low for the clam shells it was hand fed into 3/4 ton capacity tubs for unloading. Thus, each tower could conceivably unload 4,500 pounds of coal per minute, or 13,500 pounds per minute if all three towers were in operation at one time.[50]

Each tower had a pocket that held 75 tons of coal. The clam shells usually discharged their loads into these pockets, although they were designed to be able to unload directly into the railroad feed bin at the rear of the coal storage shed. A tower was served by its attendant automatic car, For loading, the automatic car was held in place on a four ton capacity scale by an automatic catch. A steam actuated gate regulated the flow of coal into the car. Thus, the car was automatically loaded and weighed in one operation, controlled by one man. The car was released by means of a foot lever, and it rolled down the track to discharge its load into the coal storage shed.[51]

On entering the shed, the car was routed to one of sixteen tracks, spaced 16 feet apart. These tracks ran the length of the building, enabling the car to unload either onto the coal piles or directly into the railroad feed bin. Coal from storage was fed into this bin by 16 pickup cars, each spaced 16' apart. The tracks for both the automatic cars and the pickup buckets were suspended from 6" x 12" rafters. The feed bin had 32 30" x 36" slide valves, steam operated, which facilitated the loading of the railroad cars.[52]

Two of the three towers of the coal hoist went into operation on July 14, 1902. The third followed about a week later. Quincy soon ran into a problem of spontaneous ignition in its coal piles, so it installed a system of regularly spaced thermometers that were inserted into the piles. These provided warning when the coal pile was heating up, enabling the company to break down the pile before it ignited.[53]

Quincy was immensely proud of its coal hoists, and directed its coal suppliers (Pickinson & Mather, Cleveland, Ohio; W. J. Scott Company, Erie, Pa.; Hannah & Co., Cleveland; and Jewett, Bigelow & Brooks, Detroit) to ship coal in the largest boats obtainable, "as we can give them as good dispatch as any coal dock in this section of the country."[54] The rapid increase in the company's use of coal made the new facility seem like a very wise purchase indeed. Between July and the close of navigation in November, 1903, the hoists handled 3,485 tons of coal, and the company projected that its consumption from March, 1903 to July, 1904 would average 6,900 tons per month.[55]

The growth in traffic generated by the new mill and coal facilities forced the company to purchase additional railroad equipment. Between October, 1900 and February, 1901, the Q&TLRR added two locomotives to its rolling stock. Quincy asked the Brooks Locomotive Works, the makers of Nos. 1, 2, and 3 to submit a bid on number 4 in February, 1900. The engine was ordered in May; the price was $10,300. No. 4 was slightly larger than its stablemates. It was a 45 ton Mogul, with 17" x 22" cylinders and 44" drivers, built in October, 1900. Q&TLRR #4 served until the end of operations in the 1940's, when it was scrapped.[56]

Quincy had considerable trouble with the workmanship on No. 4, especially with some frame welds that kept giving out. The company tried to get the maker to supply a new frame or to at least repair the old one, but without apparent success. Brooks, which became the American Locomotive Works in 1901, continually refused to accept responsibility for the failure of the welds, claiming that Quincy had overworked the engine. Quincy quickly tired of haggling with the maker and repaired the machine itself, but when the company bought another new locomotive some years later it turned to the Baldwin Locomotive Works of Philadelphia.[57]

Q&TLRR No. 5 was a ten year old Baldwin locomotive purchased used from the Hancock and Calumet in 1901. In H&C service it had been known as the "Opechee," but the name was dropped by Quincy. No. 5 was a bit smaller than the other Quincy locomotives, mounting 16" x 20" cylinders and 37" drivers. No. 5 also served until the end of operations in 1945.[58]

Quincy also purchased a number of rock cars from a variety of sources between 1900 and 1904. In February, 1900, the company agreed to buy 24 ore cars at $462 per unit from the American Car and Foundry. These were 36,000 pound capacity cars, measuring 17'x7'x4', shorter but deeper than the other Quincy rock cars. Quincy received the cars the following summer, but was displeased with the quality of the workmanship and demanded and apparently got a sizeable rebate on each car. The company obtained thirty "400 Class" rock cars from the Hancock and Calumet, so-called because their H&C numbers ran non-consecutively from 401 to 499. These were built by the Wells and French Company and were similar to

Quincy's 1-50 series cars, built by the same company. The cars were purchased in 1901, although there is no record of the price Quincy paid for them. Quincy also bought nine used rock cars from the Arnold Mining Company for $155 each in 1903. They were also apparently similar to Quincy's Nos. 1-50.[60]

Railroad technology changed very little between 1890 and 1930, at least as far as the Q&TLRR was concerned. The only major advance, and one that Quincy was quick to adopt, was the introduction of the American Brake Company's Automatic Air Brake System, which utilized a Westinghouse valve system. The addition of these air brakes increased the capacity of each car by about three tons. (This was because the engine, receiving braking help from the new system, could handle heavier cars.) By 1909 most of Quincy's 140-odd rock cars and other rolling stock had been equipped with the air brakes, and also automatic couplers. This served to further reduce costs, but, more especially, accidents. Quincy was a generally safe road anyway, but after the airbrakes and couplers were installed, the accident rate dropped off to almost nothing.[60]

The Quincy Mining Company also purchased a number of standard gauge railroad cars for use on the Hancock and Calumet line to transport mineral from the mill to the smelter. This topic is covered in more detail in a companion H.A.E.R. report, so it will be discussed only briefly here.[61]

When Quincy built its smelter in 1898, it immediately faced the problem of how to get its mill product to the smelter, since the smelter was located about five miles west of the mill. Arrangements were made with the Hancok and Calumet Railroad to haul the mineral, which was possible since the H&C had a dual gauge line. However, the system to be used was very awkward. The cars were to be raised or lowered on a very steep grade, too steep, in fact for Quincy's locomotives. The solution suggested was to lower the cars attached to an 800 ft. length of wire rope pulled by one of Quincy's locomotives at the top of the grade.[62] Fortunately, it appears that this rather unusual expedient was never tried.

The Duluth, South Shore and Atlantic, which, it will be recalled, controlled both the Hancock and Calumet and Mineral Range roads, initially was reluctant to connect a line directly from the mill and smelter. Eventually, however, they decided to build the connections. As part of the agreement, Quincy had to supply its own mineral cars.[63] Quincy ordered four 60,000 pound capacity standard gauge cars from the Pressed Steel Car Company of Chicago in 1904. The cars were made of ¼" plate, painted black and lettered in white. The cars were of a very up-to-date pattern, with Westinghouse air brakes, automatic couplers, and most other safety devices then in service.[64]

By 1910, the Quincy management in New York began to suggest that perhaps the Q&TLRR be converted to standard gauge or at least dual gauge (third rail) operation.

The primary question was economics. William Rogers Todd, the company president, believed that the rock could be hauled more effectively with a heavier standard gauge locomotive and large forty ton capacity rock cars. However, despite the persistent urgings of Todd this step was never taken, although some sections of the Q&TLRR line were converted to dual guage operation.[65]

The labor force of the Quincy and Torch Lake Railroad reflected the increased demands placed on the line by the new construction. In January, 1900, the railroad employed 21 men: 1 superintendent, 2 engineers, 3 firemen, 3 conductors, 5 brakemen, 2 engine wipers, 1 machinist, and 4 helpers. By July, 1905 the force had grown to 34 men, a 60% increase. The line now employed 1 superintendent, 6 engineers, 8 firemen, 4 conductors, 9 brakemen, 2 wipers, 1 telephone operator, 2 car weighers, and 1 train dispatcher. This does not include the 80 man/days spent repairing cars or the 60 man/days spent repairing the locomotives. This suggests that the line also employed six or eight car repairmen, although this fact is not noted in the labor records for July, 1905.[66]

By about 1905 the Q&TLRR had become a very sophisticated line for its size, as evidenced by its full time dispatcher and telephone operator. This may seem rather unusual for a line that ran an average of about six 20 car trains in each direction each day, but the number of railroad forms in the Quincy catalogue of business forms suggests that the superintendent and probably the conductors spent much of their time filling out a bewildering variety of reports. There are no less than 15 forms that would have been filled out daily, and several of these were needed for each individual train. Three forms were used for weekly reports; it appears the conductors were kept very busy with paperwork.[67]

Unfortunately, most of the completed forms have been lost. What remains are daily reports of rock shipments, and these totals are available elsewhere. About all that is known about the daily operations of the railroad is that the trains running from the mine to the mill were odd-numbered and that mill to mine trains were even-numbered. Beyond this, there is little information available on the operating procedures of the line. However, the railroad certainly had specific tasks that it had to fulfill. The various coal bins at the mine and mill had to be kept full. Otherwise, most major operations would have come to a rather abrupt halt. Conversely, the rock bins at the various rock houses had to be emptied regularly or hoisting operations would be delayed. This in fact was a major concern, and by about 1900 the company increased the storage capacity of all the rockhouses so that the timing of rock shipments was not so critical.[68]

By the end of the first decade of the twentieth century the labor force employed by the railroad had shrunk again to twenty men. In an apparent economy move the company began to use fewer locomotives but to use them virtually around the clock. By forcing the men to work more hours the labor force could be significantly reduced. Also, the locomotives spent more time in the shop for repairs as they got older, and a smaller body of trainmen were able to operate those engines that were available. Finally, the average load per car increased by three to five tons over the period, to about 16-18 tons. Therefore, fewer trains could maintain the flow of stamp rock to the mill and coal to the mine. Unfortunately, a reorganization of the railroad company in mid-decade brought an end to the detailed record keeping that would enable these ideas to be more thoroughly documented.[69]

As early as 1901 the stockholders of the Quincy Mining Company had authorized the directors of the company to "buy, purchase, acquire or lease or obtain control and ownership" of the Quincy and Torch Lake Railroad.[70] Since 1894 the railroad had charged the mine a rate for rock transport that equalled the monthly operating costs of the line (hence the very detailed record keeping). However, the railroad owed the mining company almost $300,000 in accumulated debts, mainly for construction and equipment purchases. On June 20, 1904, the stockholders of the Quincy and Torch Lake Railroad authorized the sale of the company to the Quincy Mining Company. For the sum of $190,811.23 the mining company purchased four locomotives, 17 flat cars, 119 ore cars, 1 turntable, the roundhouse and all the switches and trestles owned by the railroad. The railroad maintained ownership of the six mile main line and right-of-way. The mining company paid the railroad company $850 per month for use of this track under a lease arrangement. The sale was finalized on April 4, 1905. On that date the Q&TLRR ceased to be a legal entity and became no more than a single six mile line of track. The debt to the Quincy Mining Company was reduced to $110,494.84. Its fate is unknown, although it appears to have remained on the books until the railroad company was completely liquidated in 1925.[71]

The railroad continued under these arrangements for approximately 20 years. By 1910, however, the most hectic years of both the mine and the railroad were past and the line settled down into the pattern of operations it was to follow for the remainder of its existence. There was virtually no construction, and equipment purchases were kept to a minimum. The road continued to give good service, but its days of rapid expansion were clearly over.[72]

In 1911 Quincy and Torch Lake Railroad #1, the "Thomas F. Mason," was rebuilt after serving efficiently for about 21 years. All the other engines were rebuilt periodically during their service although one, Q&TLRR #2 was permanently taken out of service in November, 1911, and scrapped soon after. Partially to replace #2 and also to supplement the smaller engines, Quincy purchased a new locomotive from the Baldwin Locomotive Works, Philadelphia.[73]

Q&TLRR #6 was the largest of the Quincy locomotives. It was a 2-8-0, 56 tons, with 38" drivers and 18" x 22" cylinders. The engine was built in December, 1912, and delivered to Quincy in early 1913. No. 6 was much more powerful than its predecessors. The Nos. 3 and 4 locomotives could each handle trains of 24 empty rock cars from the mill to the mine. No. 6 hauled as many as 44 empty cars to the mine.[74]

Surface construction on railroad property was limited to the addition in 1912 of two "Y's", one at the mine and one at the mill. These "Y's", track sections used to turn around the locomotives, replaced the two turntables that had been built in the early 1890's. The turntables had proven to be very expensive to maintain, especially during the winter, so the much simpler and economical "Y's" were constructed. The turntable pits were filled and the track laid over them. Also in 1912 the steel railroad trestles were scraped and repainted.[75] There were no other expenses incurred by the railroad for the rest of the decade, beyond those involved with the normal maintenance of the line.

The Quincy mine and railroad began the period of decline that ultimately led to their 1931 closing immediately after World War I. The amount of material transported fell off rapidly, and by 1925 the Quincy Mining Company found it expedient to completely liquidate the assets of the railroad. The single line of track was transferred to the mining company, and the Quincy and Torch Lake Railroad ceased to exist as a separate entity. Table 3 shows the decline in the fortunes of the Q&TLRR between 1915 and 1924.

The Quincy and Torch Lake Railroad seems to pass out of the "corporate consciousness" of the Quincy Mining Company

TABLE 3
Q&TLRR Operations, 1915 - 1924[76]

Year	Tons Stamp Rock	Coal Used
1915	1,269,102	N/A
1916	1,204,026	N/A
1917	1,280,837	90,000
1918	1,174,147	49,200
1919	960,393	43,800
1920	809,263	43,477
1921	767,101	37,133
1922	674,499	N/A
1923	546,670	N/A
1924	588,167	N/A

after about 1920. There are virtually no records available, and even the Annual Reports are silent about the operations of the line. It seems reasonable to assume that the road operated smoothly throughout the period, without any extraordinary purchases, repairs, or events that were worthy of mention in the company records.

There was a burst of activity in 1925 when, for tax purposes, the company decided to liquidate the assets of the railroad company. The state Board of Assessors had fixed the value of the Q&TLRR property at $125,000, or 113% of the original cost of the property. This assessment had stood for several years, but because of the way the railroad had been included in the total mine assessment the company saw no need to question the levy. It appears that a change in the Quincy bookkeeping system and a new tax policy meant that the total would no longer be part of the total assessment, and the railroad company was faced with the prospect of paying a tax bill that it considered ruinous. The Q&TLRR Company appealed its assessment. The arguments it used in its appeal demonstrate how the Quincy saw the relationship between the mine and the railroad, and also how the arguments used in the 1889 lawsuits were simply expedients to enable the road to build its line at the lowest possible cost.[78]

The key to the company's case was the argument that "the railroad was separately incorporated, but it [was] not a railroad in the common understanding of the term; it [was] nothing more than a mine tramway."[79] Quincy claimed that the incorporation "was made necessary through the obstructive tactics of an adjoining mine which refused all reasonable offers for a right-of-way across the land."[80] Since the railroad served only the mine and that other roads connected the communities between the mine and the mill there was no reason to assess the line as if it were a legitimate commercial railroad. This argument was apparently accepted by the state, but the tax reduction was obviously not as much as the company expected. Therefore, the railroad company sold its line of track to the mining company and dissolved itself on February 1, 1927. The purchase price of $356,002.53 was immediately returned to the mining company to settle all the outstanding debts of the railroad company.[81]

For the purposes of this report, the 1927 liquidation marks the end of the history of the Quincy and Torch Lake Railroad, although the line continued to operate as a part of the Quincy Mining Company until 1931 and then from 1937 to 1945. Throughout its brief 39 year history the line played an important role in the operations of the Quincy Mine. By 1927 the line had grown to include 14.67 miles of track, the six mile mainline and more than eight miles of sidings and switches.[82] Whether the existence of the road enabled the company to save money is debatable. It is possible that the company could have saved money if it had been able to reach a satisfactory agreement with one of the local lines. The railroad was a very expensive adjunct to the mining operation. But some form of reliable transportation was essential, and the Quincy and Torch Lake provided this service and it probably saved the company in the long run. In the eyes of the company, this reliability was undoubtedly worth the expenses incurred in constructing, maintaining and operating the railroad.

NOTES

[1]The story of the Quincy Mills is told in detail in Charles F. O'Connell, Jr., "The Quincy Mills - 1858-1931," H.A.E.R. Report, 1978.

[2]Arthur W. Thurner, Calumet Copper and People (Hancock, Michigan: privately published, 1975), p. 62; John F. Campbell, "Locomotives of the Quincy and Torch Lake Railroad," Narrow Gauge and Short Line Gazette, May 1976, p. 22; S. B. Harris to W. R. Todd, March 23, 1866.

[3]Mason to Harris, January 10, 1888.

[4]Mason to Harris, April 23, 1888.

[5]Harris to Mason, June 30, 1888; Harris to Mason, July 4, 1888; Harris to W. R. Todd, July 21,1888.

[6]A. J. Corey to W. R. Todd, December 12, 1872.

[7]Harris to Mason, August 25, 1886.

[8]Harris to Mason, April 28, 1888.

[9]Ibid.

[10]Mason stresses the economic factors in a letter to Harris, June 1, 1888, for example. Most of the personal factors that influenced the decision originated at the mine, not in the New York office.

[11]Harris to Mason, May 28, 1888; Harris to W. R. Todd, June 5, 1888.

[12]Q&TLRR Cash Book, 1888 - 1893.

[13]Q&TLRR Record Book, pp. 12-15.

[14]Mason to Harris, July 5, 1888.

[15]Harris to W. R. Todd, July 21, 1888.

[16]Harris to Mason, July 4, 1888; Harris as Vice President, Q&TLRR, to John Daniell, Agent, Dollar Bay Land and Improvement Company; R. R. Goodell, Agent, St. Mary's Land Company and Highland Copper Mining Company; James H. Seager, all July 7, 1888.

[17]Harris to Johnson Vivian, July 7, 1888; Harris to W. P. Todd, July 11, 1888; Harris to D. C. Demmon, July 10, 1888.

[18]The Franklin and Pewabic takeovers are covered in much greater detail in Charles K. Hyde's H.A.E.R. report on the economic history of the Quincy Mining Company.

[19]"Confirmation by the Court of Report of Jury in the Matter of the Quincy and Torch Lake Railroad Company to Condemn certain lands for public use." Q&TLRR Records.

[20]Alfred Russell to Quincy Mining Company, April 23, 1889 and May 25, 1889, in Q&TLRR Letter Book, 1888-1892.

[21]Mason to Harris, May 3, 1889.

[22]Harris to Mason, May 22, 1889.

[23]"Confirmation by the Court ..." Q&TLRR Records.

[24]Harris to Mason, October 19, 1888.

[25]Harris to Mason, October 19, 1888.

[26]Mason to Harris, October 29, 1888.

[27]Harris to Mason, November 2, 1888.

[28]Harris to Marquette Daily Mining Journal, Marquette, Michigan, July 21, 1888.

[29]Harris to R. M. Hoar, August 7, 1888.

[30]Q&TLRR Ledger Book, 1898 - 1912.

[31]*Ibid*.

[32]Harris to Mason, October 1, 1888; Q&TLRR Letter Book; Harris to Fairbanks Morse, August 31,1889; Harris to N. H. Daniels, January 4, 1889.

[33]Harris to W. R. Todd, August 6, 1889; Q&TLRR Journal, October, 1889; J. E. Green to Quincy Mining Company, July 1, 1889, July 30, 1889; Q&TLRR Journal, June, 1889.

[34]J. E. Green to Harris, August 27, 1888; M. L. Hinman to Harris, June 27, 1888; Campbell, "Locomotives of the Q&TL," pp. 22, 27; Q&TLRR Journal, December, 1888; Journal, November, 1889; Harris to Brooks Locomotive Works, October 15, 1889.

[35]Q&TLRR Journal, pp. 29-44.

[36]Ibid.; Q&TLRR Letter Book, 1888-1892.

[37]Q&TLRR Journal, pp. 32-33, 36.

[38]Ibid., pp. 45-95.

[39]Ibid., pp. 45-108.

[40]Q&TLRR Journal, December, 1892, p. 83; Journal, December 1894, p. 107; Campbell, "Locomotives of the Q&TLRR," p. 27.

[41]Q&TLRR Journal, October 1894, p. 105; December, 1894, p. 107.

[42]Ibid., October, 1894; November, 1894, p. 108.

[43]Q&TLRR Time Book, 1892-1898.

[44]Q&TLRR Journal, pp. 109-174.

[45]Quincy Mining Company Annual Report for 1898, p. 12.

[46]Q&TLRR Journal, pp. 149-259.

[47]Typescript, "Quincy Mill," Houghton, Michigan Portage Lake Mining Gazette, October 24, 1889, pp. 1-2; Campbell, "Locomotives of the Q&TL," p. 24; Harris to W. R. Todd, February 19, 1901.

[48]Harris to John A. Meade Company, January 17, 1902.

[49]Harris to M. A. Hanna Company, January 3, 1903.

[50]Ibid.

[51]Ibid.

[52]Ibid.

[53]J. L. Harris to W. R. Todd, July 15, 1902; the fire question is discussed in numerous letters, 1902-1905.

[54]S. B. Harris to named companies, May 26, 1902; J. L. Harris to W. R. Todd, April 25, 1903.

[55]J. L. Harris to W. R. Todd, November 12, 1903; Q.M.C. Records, March 7, 1903.

[56]S. B. Harris to Brooks Locomotive Works, February 22, 1900; Harris to Brooks, May 16, 1900; Campbell,

"Locomotives of the Q&TL," p. 27.

[57]See a series of letters, J. L. Harris to Brooks (later American) Locomotive Works, 1901, especially December 23, 1901.

[58]J. L. Harris to Baldwin Locomotive Works, February 7, 1902; Campbell,"Locomotives of the Q&TL," p. 27.

[59]S. B. Harris to American Car and Foundry Company, February 21, 1900; S. B. Harris to A. C. & F., December 27, 1900; J. L. Harris to W. R. Todd, October 2, 1903; "Notes on the Q&TLRR - 1900," Q&TLRR Records; Inventory, January 1, 1903, Q&TLRR Records.

[60]Campbell, "Locomotives of the Q&TL," p. 25; Q.M.C., Annual Report for 1907, p. 13; Annual Report for 1909, p. 12. For accident data see Q&TLRR Superintendent's Report, various dates from October 1907 to December 1910.

[61]See Kevin E. Johnston's report on the Quincy smelter.

[62]S. B. Harris to Mason, April 4, 1898.

[63]J. L. Harris to W. F. Fitch, June 7, 1904.

[64]Q.M.C., Annual Report for 1904, p. 13; J. L. Harris to R. W. Hunt and Co., Chicago, August 4, 1904.

[65]W. R. Todd to C. L. Lawton, August 5, 1910, September 14, 1908.

[66]Q&TLRR Time Books, 1895-1901, 1901-1905, 1905-1907.

[67]See the Q.M.C. Catalog of Business Forms.

[68]*Ibid.*, especially "Daily Train Report."

[69]Q&TLRR Time Book, 1905-1908, and Q&TLRR's Superintendent's Reports, irregularly from 1907 to 1910.

[70]Q&TLRR Record Book, p. 63.

[71]Q&TLRR Record Book, p. 76; J. L. Harris to W. R. Todd, April 4, 1905.

[72]Q&TLRR Superintendent's Report, January 1911-January, 1915.

[73]Q.M.C., Annual Report for 1911, p. 14.

[74]Campbell, "Locomotives of the Q&TL," p. 27;

Q.M.C., Annual Report for 1913, p. 22.

[75] Q.M.C., Annual Report for 1912, pp. 19-20.

[76] Q.M.C., Annual Reports for 1917, pp. 17-18; 1918, p. 18; 1919, p. 17; 1920, p. 15; 1921, pp. 15-16; "In Reference to the assessed valuation of the Quincy and Torch Lake Railroad," Q&TLRR Records.

[77] See Q&TLRR Records pertaining to the 1925 tax appeal, part of the general record collection.

[78] Untitled Report, Q&TLRR Records.

[79] Ibid.

[80] Ibid.; Q&TLRR Record Book,; Q&TLRR Journal, Entry for February 28, 1927, p. 303.

[81] Q&TLRR Record Book.

[82] Q.M.C., "Length of the Q&TLRR."

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