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Preserving and interpreting the mining company office : landscape, space and technological change in the management of the copper industry

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PRESERVING AND INTERPRETING THE MINING COMPANY OFFICE:
LANDSCAPE, SPACE AND TECHNOLOGICAL CHANGE
IN THE MANAGEMENT OF THE COPPER INDUSTRY

By

Renée M. Blackburn

A THESIS

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This thesis, "Preserving and Interpreting the Mining Company Office: Landscape, Space and Technological Change in the Management of the Copper Industry," is hereby approved in partial fulfillment of the requirements for the Degree of MASTER OF SCIENCE IN INDUSTRIAL ARCHAEOLOGY.

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ABBREVIATIONS

The following abbreviations are used throughout the text.

C&H	Calumet & Hecla
HAER	Historic American Engineering Record
KNHP	Keweenaw National Historical Park
MTUA/CCHC	Michigan Technological University Archives and Copper Country Historical Collections
QMC	Quincy Mining Company

ABSTRACT

The purpose of this research is to examine the role of the mining company office in the management of the copper industry in Michigan's Keweenaw Peninsula between 1901 and 1946. Two of the largest and most influential companies were examined – the Calumet & Hecla Mining Company and the Quincy Mining Company. Both companies operated for more than forty years under general managers who were arguably the most influential people in the management of each company. James MacNaughton, general manager at Calumet and Hecla, worked from 1901 through 1941; Charles Lawton, general manager at Quincy Mining Company, worked from 1905 through 1946. In this case, both of these managers were college-educated engineers and adopted scientific management techniques to operate their respective companies.

This research focused on two main goals. The first goal of this project was to address the managerial changes in Michigan's copper mining offices of the early twentieth century. This included the work of MacNaughton and Lawton, along with analysis of the office structures themselves and what changes occurred through time. The second goal of the project was to create a prototype virtual exhibit for use at the Quincy Mining Company office. A virtual exhibit will allow visitors the opportunity to visit the office virtually, experiencing the office as an office worker would have in the early twentieth century. To meet both goals, this project used various research materials, including archival sources, oral histories, and material culture to recreate the history of mining company management in the Copper Country.

CHAPTER ONE

INTRODUCTION AND GOALS

Typical heritage interpretations of historic mines often emphasize the workers' points of view, featuring dangerous underground places and sprawling dirty surface plants. However, mining companies and their sites are complex places that incorporate the needs of the workers, the realities of the mine site, and the often-conflicting views of management regarding operations. This project addresses two major goals in preserving and interpreting an overlooked part of the surface plant of a mine: the mine office. The first goal of this project is to address the managerial changes in Michigan’s copper mines of the early twentieth century. To do this, an analysis of the Calumet and Hecla (C&H) and Quincy Mining Company (QMC) office buildings is necessary to determine how the changes within the office building, from personnel to building modifications, reflected the company’s successes and failures from 1901 through 1946. A second important goal of this project is a prototype virtual exhibit of the QMC office’s interior and exterior that will allow the visitor to virtually experience the building and its surrounding landscape, and see the organizational structure and layout of the office as it developed through time.

The office building is a familiar sight on the greater mining landscape; however, to those who did not work within it, the building and its internal operations can be a mystery. The mineworkers’ only access to the office may have been through a back door and separate pay room. The pay office was part of the office building, but there was no access to the rest of the building for those who did not work within. Overall, the mine office was an integral part of the mining landscape, where many activities took place –

from small vestibules where workers received their weekly pay to drafting rooms where designers drew up plans for all aspects of the mining operations to the office of the company president from where operational decisions flowed.

During the early twentieth century, new management ideas began to trickle into industrial management around the United States. As companies entered a new century, they looked to streamline their processes and cut costs whenever possible to keep up with the fast-growing industrialization of the rest of the country. Changes to all aspects of manufacturing industries began and extractive industries, like mining, were no exception to this change. Around the turn of the twentieth century, college educated mining engineers began to take on more important roles. A new regime was beginning to emerge, one that would change the structure of mine organization to react to the changing needs of society in the twentieth century.

As part of this new regime, mine engineers, in particular, took the reins away from the "old regime" and began to implement changes to the structure of mining management. These new engineers began to take more leadership positions, including that of general manager of the mine. The principles of scientific management began to take a firm hold in the early 1910s, and the new regime of mine engineers led the way in mine efficiency to cut costs. Specific details regarding every aspect of mining, and an emergence in cost accounting and the professionalization of business, created change that directly affected the lives of workers underground – a bone of contention among many.

During this time of regime change, another group of workers began to infiltrate the working world in larger numbers. Women, who had been fighting for equal rights to men, began obtaining positions in offices as stenographers, typists, telephone operators, and clerks. These jobs, previously considered male's work, began to shift the operations of companies and many saw the inclusion of women as a threat to what they had worked hard at establishing. Middle-class workers had transformed office work into professional work that displayed prestige and masculinity, a concept that was altered by the introduction of women into the office workplace (Srole 1996).

World War I severely affected operations and caused many of the changes made in the previous fifteen years to take a step back. Though business boomed for some, the roles of those in the office shifted again, re-cementing previous ideas about management. As the war raged on, new ideas developed regarding the professionalization of business and its importance in the whole of office culture. This created a rift in the relationships between groups of workers in the office setting, as now positions that had been defined by males for males in the nineteenth century, once again became to be seen as male-only positions. As companies struggled to return to normal operations after World War I, they were to deal with more difficult times in the 1930s and 1940s as the Great Depression and World War II placed a huge burden on operations.

The first goal of this paper is to address the managerial changes of the early twentieth century. The first point of view is from those in the mining industry who wrote texts regarding mine management in the early twentieth century. These texts are not only dedicated to mine office management ideas, but to the operations of the entire mining landscape. Inside the texts were written basic instructions on how best to organize mine management and how to address each task of the management process. In contrast to this are the writings of late twentieth century scholars, looking back on the actual operations and implementations of various management initiatives. These texts often express how exactly management incorporated current management styles while attempting to keep their companies successful. Although the authors of the early texts believed that all their ideas needed to be implemented for proper operations, often, management chose what they thought would work best and modified it from there.

Calumet and Hecla and Quincy Mining Company – Two Case Studies in Mine Management

As a case study for these managerial changes during the early twentieth century, the main office buildings of two companies, Calumet and Hecla (C&H) and the Quincy Mining Company (QMC) will be studied. Both companies constructed their mine offices in the late nineteenth century; however, changes in mining management trends and the gradual decline of operations after 1900 affected the ways in which people operated within the office space. The goal of this project is to determine how changes within the office building, from personnel to building modifications, reflect the companies' successes and failures from 1901 through 1946.

During the years 1901 – 1946, each company operated under a long-serving general manager who would be considered one of the most influential in the company's history. From 1901 through 1941, James MacNaughton was the general manager of Calumet and Hecla, while, from 1905 through 1946, Charles Lawton was the general manager of Quincy. Both of these men were the longest to hold their position at each company and much change occurred within management during their time as general manager. In a change from the previous mine managers, both MacNaughton and Lawton were college-educated. Though each had his viewpoint on how best to operate their respective companies, both struggled through many of the same troubles.

Additionally, by 1900, both companies were operating with much success. In the 1900 *Copper Handbook*, Stevens wrote, “The Quincy is as the world’s greatest amygdaloid mine as the Calumet & Hecla is the greatest producer from the conglomerate” (219), affirming the fact that both companies were major players in Michigan copper production at the beginning of the twentieth century. However, both MacNaughton and Lawton faced much hardship while operating their respective mines. Declines in copper prices, worker unrest, and the effects of two World Wars ultimately decided the fate of each company.

The twentieth century in Copper Country mining is defined by two periods, one from 1900 – 1920, and the second from 1920 – 1960s, when the major players, C&H and Quincy, closed operations for good. This first period is defined by major events in copper mining, including the strike of 1913 – 1914 that caused a huge blow to the companies, to the boom years of the first World War when copper was once again a hot commodity. The second period marks the major decline of the companies, from which they would not recover (Lankton 1991). Quincy fought to stay afloat during the Great Depression, though they shut down operations from 1931 – 1936. Their final debilitating blow came with the low demand for copper during World War II. Calumet and Hecla, still Michigan’s largest producer of copper in the twentieth century, managed to stay in somewhat profitable operation through much of the turmoil of the mid-twentieth century. However, major labor unrest coupled with the costs of extracting copper eventually caused them to shut their doors in 1968.

An important product of this research will be a study of the physical presence of office buildings as community features. Through analyzing the office's location on the landscape, the materials of which they are built, and how the buildings continue to operate in the current landscape, a more complete story about mining company operations can be told (Figure 1.1). For example, in the case of QMC, many of the local people equated the office building's architecture and location with the office clerical staff's ability to operate the "world's richest mine" (Eckert 1993). Both QMC and C&H used expensive local resources, on both the exterior and interior, and east coast architects to construct office buildings that portrayed the dominance and permanence of the mines in the Keweenaw (Hoagland 2010). In the case of both companies, architectural choices were a way to advertise their companies as an important, integral part of local life. However, as the companies began their gradual decline, the role of the office to the greater mining landscape also began to decline. At the end, the offices were all but abandoned.

Methodology and Analysis

In order to fully understand the role of the office in the greater mining landscape, multiple methods are necessary to analyze the office structure and culture of C&H and QMC. In addition to scholarly sources, three main methods will be used to analyze the office – material culture, archival sources, and oral histories. Object and archival collections from the MTU Copper Country Archives and Historical Collections and Keweenaw National Historical Park (KNHP) will help determine how the offices were organized and how those within operated the mine as a whole. Correspondence, between

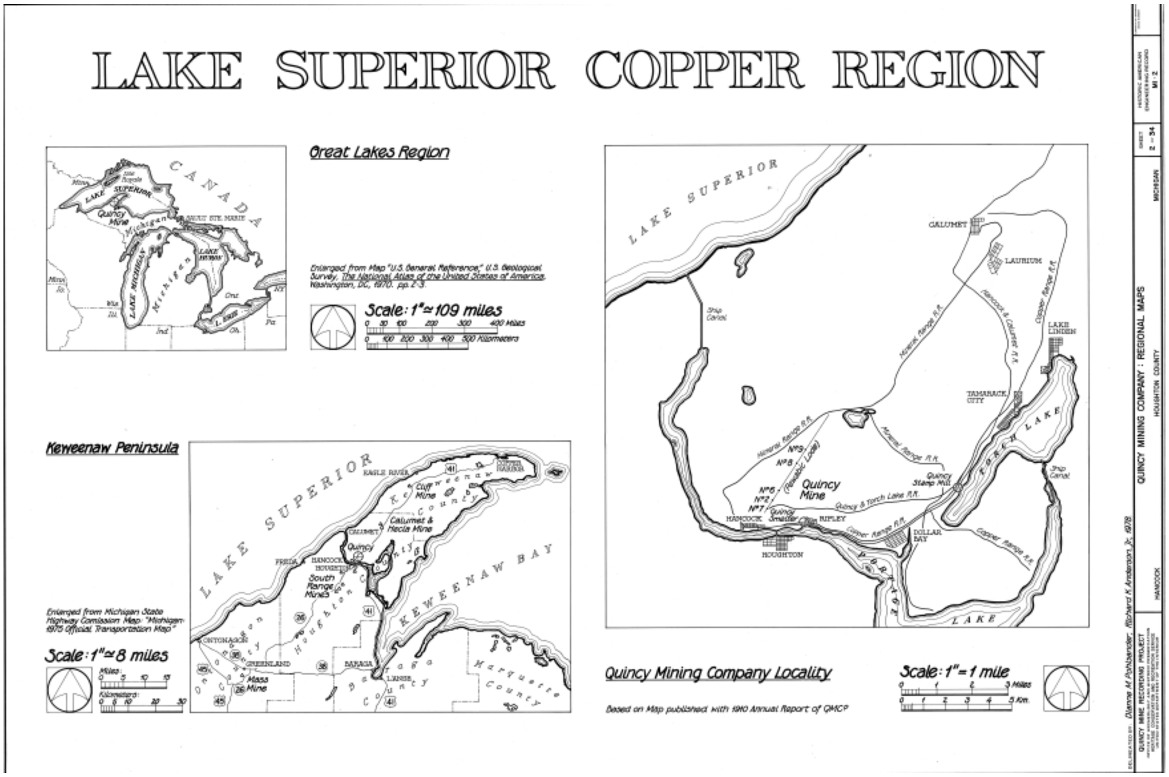

Figure 1.1: Map of Michigan showing the Keweenaw Peninsula and mines. Drawing courtesy of Historic American Engineering Record, Quincy Mining Company, 1978.

the mine office and the corporate offices in New York and Boston, for example, will be analyzed to look at the relationship between management and the decisions being made regarding the operations of the mine.

Part of this project will use objects cataloged during summer 2010 while I was employed at the Keweenaw National Historical Park. During that time, I cataloged a majority of the objects recovered from the Quincy Mining Company office and roughly 200 objects from the Calumet and Hecla general office building. KNHP also conducted oral history interviews in the early 21st century with workers who previously worked for C&H in the mine office. Though not all date from the time period in question, many of their experiences were dictated by management styles and changes that came into effect during the first half of the twentieth century. Through engaging the local community in discourse, specifically in the form of oral history, regarding the office's role, mining managerial patterns can be demystified.

The buildings themselves also reveal information regarding management operations. The materials of which the buildings were constructed, their location on the landscape, and how the mineworkers experienced the office all affect management's role and dominance over the local landscape. The exteriors of the offices were not the only way in which the companies displayed their dominance over the area. Through an analysis of the materials from the inside of the building, including the interior woodwork, layout, and office equipment used, the project will tell the story of the office's role in mine management as well as how the management of the mine addressed the growing technological needs and social changes in the workplace that occurred in the first half of the twentieth century. KNHP owns both office buildings, operating the C&H office as their headquarters and renting out space in the QMC office to other local organizations.

Exhibiting Mine Office Culture

A second important product of this project is a prototype virtual exhibit of the QMC office's interior and exterior that will allow the visitor to virtually experience the building and see the organizational structure and layout of the office as it developed through time. This exhibit addresses technological changes in office artifacts, the introduction of new accounting practices, and personnel changes, such as the introduction of mining engineers and women in the office workplace. An exhibit of the internal office managerial structure and its changes over time will engage the visitor in the operation of the mine from the manager's perspective.

The creation of a virtual exhibit allows for various levels of interaction for the viewer. There are currently many examples of virtual exhibits available on the Internet. Included in this is the Early Office Museum [1], which exists only online and is a compilation of written office history throughout the late nineteenth through the twentieth century accompanied by photographs. Additionally, there are other online museums dedicated to virtual exhibits, including the Wolverhampton History and Heritage website[2], which focuses on the town of Wolverhampton, England. Through this website, the viewer is able to click through links that allow them to read the history of the town as well as view images. The Virtual Museum of Canada[3] consists of various virtual exhibits that tie together important local and national history, text, images, and sound files to tell a story. On another scale are the National Museum of American History's online exhibits[4] featuring important aspects of American history. One of their more recent virtual exhibits focuses on industrial drawings from the Smithsonian and displays the drawings online with short descriptions of each work.

Many people view the role of a museum and exhibit as simple\y the care of valuable historic objects. However, in the case of the mining office, the interior and its functions can be something of a mystery. The Keweenaw National Historical Park has a wide variety of artifacts from the QMC office, including documents, furniture, and

[1] http://www.officemuseum.com
[2] http://www.localhistory.scit.wlv.ac.uk
[3] www.museevirtuel.virtualmuseum.ca
[4] http://americanhistory.si.edu

"everyday" office objects, that will be directly used in this exhibit[5]. Additionally, audio and video sources, including audio recordings of correspondence and videos of the current office interior, will allow the visitor to see how time has affected the office and how much has changed in the past century.

The virtual exhibit for QMC uses ArcGIS software, particularly ArcScene, to create a 3D model of Quincy Hill as the base layer. To create this, Sanborn Fire Insurance maps from various years are georeferenced onto a current satellite photograph of the area. By using multiple maps, the virtual exhibit will be able to show change over time on QMC's property a also allow the visitor to experience the site without having to visit. It will also show what the landscape used to look like in 3D, hopefully providing better insight into the complexity and massive nature of mining operations in the area. This 3D model of Quincy Hill will include hotlinks that can be clicked on to reveal information about the building via photographs, text, and audio and video clips.

Ultimately, the overall success of this project depends partially upon the information found regarding the internal structure of the office but also upon the oral history accounts, objects, archival sources and successful virtual exhibition of the office. Although they are part of the mining landscape, the office buildings currently are largely left out of the mining story in the Keweenaw. Interpretation of the buildings, their place on the landscape and their place within the operation of the mines will give visitors and the local community, where living ties to copper mining still exist, the opportunity to experience an often mysterious aspect of mining operations and decision making.

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[5] Quincy objects part of KNHP Quincy Mining Company Collection, accession # KEWE-00033.

Organization of this Project

This project is arranged into six chapters, including this introductory chapter, and broadly covers two themes. The first theme is that of business and management development in the early twentieth century and how these changes played out in the management of two major copper companies in Michigan's Keweenaw Peninsula. Chapter two focuses on the existing literature regarding management changes. The chapter is focused on detailing the ways in which management ideas changed business practice in the early twentieth century. These changes include the increased status and importance of the engineer in management, particularly in the mining industry, the role of new office technologies and gender changes in the office, and the introduction of new management ideas, like scientific management. Additionally, this chapter analyses texts from the later twentieth century that address management changes related to mining.

Chapters three and four are case studies in early twentieth century mine management. Chapter three focuses on the most successful copper mining company in Michigan's Keweenaw Peninsula, Calumet & Hecla. This chapter outlines the ways in which management in the mine office in Calumet, Michigan operated the company. The longest-running general manager of the company was James MacNaughton, who operated in that role from 1901 through 1941. MacNaughton is arguably the most influential individual in company history. Chapter four details the Quincy Mining Company and their operations from their mine office located atop Quincy Hill in Hancock, Michigan. Much like C&H's long-running manager, QMC also had a single general manager/superintendent throughout the early twentieth century. Charles Lawton acted as QMC superintendent from 1905 through 1946. Lawton led Quincy through the company's peak and major decline in the forty years in which he was superintendent.

The second theme in this project is one of preserving and interpreting the office for the future. Chapter five focuses on the creation of a virtual exhibit for the Quincy Mining Company office building. An analysis of the world of virtual exhibits and museums and their development over the past two decades, including ways in which memory and space are created in the virtual world, is provided. This is followed by examples of successful virtual exhibits and museums with themes that could be modified to the advantage of a QMC office virtual exhibit. The beginnings of a virtual exhibit of the surrounding landscape are then incorporated through the use of ArcGIS software. Using Sanborn Fire Insurance maps from the early twentieth century that represent the properties on Quincy Hill in the view shed of the office, 3D replication allows the user to see the changes in the landscape through time and to experience a landscape that is no longer intact. A brief plan for a virtual exhibit of the interior of the office is also suggested.

Chapter six is the concluding chapter of the project. This chapter synthesizes the previous chapters to summarize the way in which each company operated during the early twentieth century and how changing management ideals and the introduction of new types of workers and professions affected mine management. It also covers the final years of each case study company. Both companies operated into the 1960s and the office buildings still played a role in company management, though at different scales than in the early twentieth century. This chapter will also summarize the creation of a virtual museum for the QMC office building.

CHAPTER TWO

LITERATURE REVIEW

Throughout the twentieth century, the office has "represented the face of American business to the world" (Albrecht and Broikos 2000: 17). The buildings themselves have come to represent success and technological innovation of companies. Changes in management styles and the introduction of large corporations sparked the need for large-scale, methodical offices that began to emerge around 1900. The major factors in this shift to the new office culture were the infiltration of scientific management techniques, change in the educational backgrounds of management employees, and a shift in gender composition of the office (Albrecht and Broikos 2000). These changes were all evident, in various forms, during shifts in mine management at the beginning of the twentieth century.

Early twentieth century mining texts all alluded to similar, general themes in regards to mine management. Even before the full-fledged introduction of scientific management into the mining industry, many of the basic ideas had started to infiltrate mining. Mine management as a structure began to change not only in terms of management ritual, but also in management composition and personnel. At this time, the mining engineer began to gain more ground inside management and it was often written that, rationally, engineers should comprise the top management positions at a mine because of their scientific knowledge and expertise. As more "scientific-minded" men entered top management positions, the role of management underwent a "scientific" change, much like the greater mine workforce.

Mine Management Ideas in the Early Twentieth Century

In 1909, Herbert C. Hoover, mining engineer and future U.S. President, wrote regarding the changes that occurred in the past century that affected the way in which mining operated in the early twentieth century. Though this was written before scientific management gained a stronghold in the mining industry, Hoover addressed some of the potential changes that would take place under the efficiency engineering and scientific management movement in the early 1910s. In his book, Hoover wrote about the increasing importance of the mining engineer as the "executive head in the operation of mining engineering projects" (1909: 190). He further expanded by saying that the role of the engineer has been increasing, as more engineers are filling the roles of foreman, supervisor, manager, and even company president.

This rise of the engineer, so to speak, is a precursor to the changes that would be pushed for under scientific management. While discussing the role of the engineer in the future of mining, Hoover at one point stated that, "to the engineer falls the work of creating from the dry bones of scientific fact the living body of industry" (Hoover 1909: 193). This management shift, according to Hoover, created some contempt between those people who were trained in the previous style, that of individual enterprise and simpler mining and engineering techniques, and the new technically-minded university-educated engineer.

However, as mine management began an internal shift in the types of people employed, the way in which a company was operated also shifted. In order to have the "best" management personnel, it became important to know the backgrounds of individuals and make sure that their diversity would adequately cover the tasks necessary and that they would add to the management perspective in terms of knowledge diversity. Hoover used mine accounting as an example of how well management operated the company from the corporate headquarters' perspective. He stated that mine accounts could be used to provide statistical data to the corporate office, which allowed them to easily see how the company was doing, while also helping to guide the mine management to solve problems in areas that may be lacking what they thought was efficient organization (Hoover 1909).

Oscar Hoskin looked at mine management as something that one cannot learn but was inherently within one. Unlike Hoover, Hoskin's point of view did not match the initial stirrings of scientific management in the mining industry. Though he also discussed the importance of the engineer, it was from a different viewpoint, one akin to the pre-engineering management ideals. One of his final chapters discussed the management of mines. He claimed that mine management was not something one could learn, but having the necessary personality characteristics is something with which one is born. Though, this was not the only way to become a successful administrator at a mining property. Mine administration, he stated, must also have a keen insight into the work that happens at the mine. They must understand geological and engineering principles. Hoskin said that, because one may have been a successful manager in another industry, does not mean he will be successful in mine management. Hoskin believed mining to be a unique industry that not anyone could enter and succeed as management. In terms of the officers and directors of the mine, Hoskin showed caution in putting those outside of the mining industry onto boards as directors. He said that, though it happens often, it was better if the directors had experience, both underground and above ground, and good ideas when it comes to mining (Hoskin 1912).

Though his ideas on how good management formed varied from the ideas of the period, Hoskin was also a proponent of the importance of mining engineers. He said that many mining companies put great stock into choosing their engineers and keeping the engineering department in good form. After the mine superintendent or general manager, the engineer was next in line in terms of management hierarchy. The engineer needed to have skills in multiple disciplines, including geology, physics, mathematics, and drafting, and, when the mine manager was not there, the engineer was next in charge. One duty of the engineer was to take samples, and not just at the time of a sale. Instead, the engineer needed take samples and give detailed accounts of their characteristics. Some duties of both the manager and the engineer include writing monthly, quarterly, or annual reports.

Many of the ideas posed in mining texts of the early twentieth century had roots in the scientific management movement. Frank Carlton used Frederick Winslow Taylor’s ideas of scientific management, also called efficiency engineering, to discuss how to implement changes brought about by scientific management to the benefit of all involved. He claimed that the rise in efficiency principles grew out of the changing face of industry in the United States. As industry had expanded to all corners of the country, the need for more efficient industrial processes came into being so as to continue to keep operations running smoothly.

Carlton claimed that there were two basic principles of scientific management – one was “efficient systemization” and the other “psychological,” in that scientific management called upon employers to create incentives for workers based on their psychological profile (835). This idea showed the continued presence of worker stereotyping and prejudice from the management "class" towards the working "class." Carlton continued to base his argument around a statement that Taylor wrote in his "Principles of Scientific Management," regarding the relationship between the worker and the manager, "This close, intimate personal co-operation between the management and the men is of the essence of modern scientific or task management" (835). One of Carlton's main issues was that, to the worker, the scientific management or efficiency engineering systems appeared to only benefit the management and company. He stated that, while men working for their own profit, like farmers, gladly accepted a tool that would help them do the job in less time while earning greater profits, men who worked for a company did not see the benefit of working less. In their opinion, this meant that the labor force decreased, potentially putting them out of work.

However, Carlton added that one of the main concessions in this is that the workers would like a shorter shift. If they were to work more efficiently, he claimed, then they should reap some benefit from the increased wealth of the mine in terms of more time outside of work. This is where Carlton discussed the rift between management and the workers in the scientific management system. Instead of working together cooperatively, the system created a larger divide between management and workers, and, according to Carlton, left room for labor unions to enter and fill the void. Carlton appeared to say that, in order for efficiency engineering to be successful, management must understand the workers' point of view, and attempt to assuage their negative feelings.

Glenville Collins (1912) agreed that understanding the workforce is the key to effective efficiency engineering in mining. He claimed that management must provide high wages for workers, which in turn would mean that workers would be willing to work more efficiently and accept changes in the workplace enforced by management. This extended not only to underground and surface plant workers in mining, but also to the management of the office. Collins suggested the use of a card system to help streamline office work, specifically in the payroll department. In this system, the worker kept track of his own card, which was then checked by the foreman. But Collins' idea had an ulterior motive in that, not only would it streamline the payroll process, but also provide management with a "who's who index of the best workmen" (1912: 653).

Collins argued also that although workers would be more accepting of a new system if it means higher wages and that any changes should be applied "gradually, but firmly," in order to quash any negative reactions from the workforce (1912: 653). The overall point of Collins' argument was that high wages should equate to low costs, which means higher profits for the company. He suggested that management follow the four principles of scientific management[6] as advocated by Frederick W. Taylor. In this, Collins advocated for a structured workday for each worker in which he arrived at work and was immediately given his assignment for the day. Compliance on the part of the worker would be gained through higher wages and knowing that, if he did not complete his task, he would eventually pay the price for his "disobedience."

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[6] These four principles are 1. A large daily task; 2. Standard conditions; 3. High wages for success; and 4. Loss in case of failure (Collins 1912: 654). They originally appeared in Taylor's paper, "Shop Management," *Transactions of the American Society of Mechanical Engineers*, xxiv (1903): 1337 – 1456.

To incorporate the new changes, Collins offered a five-step[7] process for ease and effectiveness. He claimed that, though maximum output cannot be achieved overnight, these steps would help speed up the process. Essentially, through implementing efficiency engineering and scientific management principles, Collins turned all aspects of the mining industry into scientific experiments. Mining was already a highly scientific industry, but not in all areas. Through scientifically based organizational changes throughout the entire company, mining would begin to benefit the entire workforce and the company as a whole.

George Young (1916) [8] took a management-centered approach to mine organization. Young devoted an entire chapter as a guide for how a mine company should be organized. He explained the roles of the corporate management and the stockholders, and made a point to mention that the stockholders elected the board of directors. It was the directors' duty to represent the stockholders; however, at times, the directors and the corporate management consisted of the same individuals.

Young spelled out the organizational structure of the mine as well. He defined a hierarchical structure with the general manager at the top, followed by department heads, who each had people under them that reported to the department heads and represented the "general" workforce in their departments. While each person reported to the person above them in the hierarchy, Young claimed that, in certain situations, the department

[7] Collins' five-step process included, "1. The selection of a man of wide experience, not a miner, geologist, or mill-operator, but a man who has especial ability to observe what is actually going on, to take part in it, and to win the confidence and help of all the workmen. 2. The standardization of tools and methods throughout the mine, mill, and office. 3. The scientific study of time required to do a unit-work in all lines. 4. The establishing of a card-system by which the workman can transmit the required information to the planning-department. 5. The making of a complete analysis of each piece of equipment used, and establishing a graphic-chart system of its operating efficiency" (Collins 1912: 659).

[8] 1916 is the original year in which Young published his book, the edition cited is from 1933.

heads had the authority to run their departments as they saw fit, including hiring and firing employees.

This hierarchical management style expanded beyond the structure of the workforce as Young discussed how work should be divided and organized. Administrative work should be divided equally, while the general manager should be always aware of how much work his employees have. If they were overburdened, then some of the workload must be removed, and if they were under-burdened, then some more work must be added. At the same time, Young called for detailed, evenly spaced intervals of tasks, such as company inventory, which should be completed throughout the year. This also included a reports system, wherein each department wrote a daily, weekly, and monthly report to the manager summarizing the work at their department, which allowed the manager to stay up-to-date on the workings of each department (Young 1916). Overall, Young's approach to mine organization provided a very practical overview on how to organize a mining company to run efficiently.

Along the same lines as Young, Robert S. Lewis (1933)[9] called for a management hierarchy in which the manager was in ultimate control of the company. Lewis discussed the difficulties in maintaining order in large companies and stressed the importance of organization. His work emphasized many of the ideas of mine management that began to emerge in the early twentieth century that were refined within the first few decades. Lewis heavily emphasized the importance of the manager to delegate work and to not overburden himself with too much administrative work. Lewis stated that, "It is

[9] Lewis' original text was written in 1933; the 1964 edition is cited here.

preferable to delegate this detailed work to subordinates and to give them freedom of operation, judging them by result" (745).

Lewis also discussed how the manager should be spending his time. He defined the role of the manager to include labor relations, business relations, and implementation of new technological advancements to move the company forward[10]. In addition to business practice, the manager was also responsible for the employees' safety and welfare[11]. Ideas that emerged in the first few decades regarding mine safety put the manager in charge, even though Lewis stated that each department head was responsible for his own department and report to the manager with updates.

S.J. Truscott (1929) addressed the entire system of scientific management in mining and efficiency engineering, detailing the processes involved in successful adoption of scientific management principles to mining. In an overly dramatic tone, Truscott defined mining as "the industry which wrests the material of mineral deposits from the earth's rocky crust and delivers it at the surface" (1929: liii). Expanding upon this, Truscott claimed that mining, out of all industries, was the most in need of efficient management, mainly due to the fact that the nature of the work underground was especially hazardous. With this also meant that the expenditure upon labor and

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[10] Lewis writes in detail regarding the role of the mine manager, which implies that the manager has been educated as an engineer and has a wide range of experience working at the mine. "The problems of the manager are the efficient handling of labor and the infusion of morale into the working force, the following of proper legal and social procedure in the transaction of business, the applying of new discoveries in physical science that would improve the technical work of the organization, the efficient marketing of products, the maintaining of adequate finances and the coordinating of all departments of the organization" (Lewis 1964[1933]:745).

[11] "The safety and welfare of employees are an integral part of mine administration. Under this category are included the physical examination of all applicants for employment, safety information through bulletins, display posters, committee meetings and personal instruction, accident statistics, compensation, insurance, rentals, repairs, sanitations, police protection and maintenance of the mining camp" (Lewis 1964[1933]:752).

management was higher than in other industries and management's main focus should be the elimination of waste throughout the entire business.

Truscott named two types of management, scientific and technical, in which mining companies operated. The major principle adopted from scientific management included the removal of responsibility and decision making from the workers, which was given to the management[12]. As a smaller subset of scientific management, technical management focused on two branches, efficiency engineering and supervision. Efficiency engineering consisted of the branch that "ascertains facts, makes tests, digests data, works out standard performances and thinks out plans which shall result in economy," while supervision consisted of the branch that "gives a detailed plan to follow and a standard of performance which to aim, is charged with the endeavour to attain the budgeted results" (Truscott 1929: liv-lv).

Under efficiency engineering, Truscott listed and detailed various studies that should be undertaken. The first were time studies in which a detailed analysis of the amount of time taken to do each task was recorded, including various conditions associated with that task, and then a determined amount of time was associated with each task. This allowed management to create detailed task lists for workers each day. Truscott also discussed mechanical studies, which are similar and related to time studies. In this, there is more of a focus on an individual machine or worker and the efficiency of work as a whole. Studies in mining, like these, were tied into the results that management came to regarding work at the mine. Creating detailed instructions and

[12] Specifically, Truscott stated, "Under it [scientific management], responsibility is withdrawn from the shoulders of those who carry out work and placed upon those who direct the work, where it more rightly belongs" (1929: liv).

standards for workers were common and seen as important to the mining operation. These studies and their results came from newly developed study and planning departments within management that not only compartmentalized the work of the miner, but also indirectly the work of management, as more people were needed to complete specialized tasks within the management structure and keep track of their changing status.

The second branch of technical management, supervision, was more directly related to management structure and work. Supervision gave power to officials who distributed the workload, supervised work, and watched over the entire work process to make sure that it ran smoothly and any inconsistencies or problems were quickly resolved so that full efficiency could again be realized. This branch relied on a hierarchical structure of managers and under-managers that were each responsible for a specific section of supervision.

Overall, Truscott emphasized the role of management in mining and the way in which the workers should perceive it. Truscott claimed that workers should believe that management only has their best interest at heart and also have faith in the management to competently operate the company. In other words, Truscott wanted the workers to put all of their faith in the business into the hands of the management and believe that, even in tough times, management would come to their aid. Emphasis of this image became more important as changes in management and work practice had the potential to create a barrier and lack of trust between employee and management that would thus have the potential to create tensions in the workforce with the implementation of more efficient work.

Early twentieth century mine management ideas were driven by the end goal of profits for the company. The focus of mine management was to be on the total efficiency of the worker, though changes in management practice had to change along with this new efficiency. Many of these writers noted that tensions between management and workforce over the intentions of more efficient work may be problematic, but management, they said, had the upper hand in the situation. In a way, they believed that management should act as the stern father to their workforce children. Management knew what was best for the mine and for the workers, and thus a more efficient system of operations would be best for all involved.

Late Twentieth Century Views of Scientific Management and the Rise of the Engineer

Reinhard Bendix (1959) explained the changing image of the employer in scientific management[13]. Bendix claimed that the adoption of scientific management principles modified the image of the employer, he stated that the employer went, "From a man whose success in the world made him the natural leader of the industrial order he had become a leader of men whose success depended in part upon a science which would place each man in 'the highest class of work for which his natural abilities fit him'" (1959: 280). Taylor also believed that management was not easily persuaded to adopt the principles of scientific management. As Taylor's principles created more, or at least a different, types of work for the laborer, the same was true of management. Bendix claimed that this reluctance on the part of management was based upon the fact that

[13] Republished with a new introduction and updated information in 2001.

Taylor's new principles directly questioned the validity and soundness of the decisions that management had been making for years prior. However, Bendix's main point is that Taylor's principles didn't appeal to employers who were looking for answers to increased unionism, amongst other things, and even when they did adopt scientific management principles, they still did not believe it would solve these issues. Bendix made one important note, however, in that what management adopted from scientific management was more "the social philosophy rather than the techniques" (1959: 281).

Expanding upon Bendix, Harry Braverman (1973)[14] detailed the development of modern business in the late nineteenth and early twentieth centuries. One of the major changes in business practice that occurred in the early twentieth century is the proliferation of scientific management principles as developed by Frederick Winslow Taylor. Braverman defined scientific management as, "an attempt to apply the methods of science to the increasingly complex problems of the control of labor in rapidly growing capitalist enterprises" (1973:59). The key point of this definition is Braverman's use of the word "attempt" in the definition. He argued that actual scientific principles were not applied to scientific management because the outcomes were based on the opinions of the management implementing the changes.

One major contribution of Taylor's scientific management to the business world was the idea of management-initiated studies of work. Though not a new idea, Taylor took previous ideas of work-study and implementation of structured tasks from the works of Charles Babbage and Henri Fayol, who spoke of these ideas in terms of administration, not the general workforce. Another major focus of Taylor's work involved control in the

[14] Republished in 1998 with new introduction and updated information.

work environment. Though also not a new idea, control over work from a management point of view was taken to a detailed level and places in stages in which Taylor documented every step for each worker to be their most efficient and for the business as a whole to be as efficient as possible. The idea that management had control over the workforce only in terms of telling the workers what to accomplish was a practice that Taylor wished to expand upon. Instead, Taylor claimed that management would only be frustrated, unless they were in ultimate control of the workforce. The ways in which Taylor proposed this control were his principles of scientific management. As Braverman stated, "Taylor created a simple line of reasoning and advanced it with a logic and clarity, a naïve openness, and an evangelical zeal which soon won him a strong following among capitalists and managers" (1973: 62.63).

The second principle Taylor set forward was the removal of "thinking" on the part of the worker, and moving it to the planning department of the organization. Taylor considered this the most important aspect of scientific management. As Braverman stated, this principle allowed management to separate the thought from the execution, thus breaking down the individual laborer to a more simple form. By doing this, then, management would be able to implement changes, like increased efficiency techniques and a quicker pace of work that would not have been possible if the workers were able to remove conception from the work process. Braverman referred to this as the "principle of separation of conception from execution" (1973:79). Once the step of conception of work is removed from the processes of the worker, their control over the labor process has effectively been given to the management who can "afford" to study it (Braverman 1973:80).

Taylor’s third principle involved the planning of daily tasks for each worker to complete. Though it was known that workers were the experts in their area of work, in order for management to gain some sense of control over the situation, a set of daily tasks explaining what is to be done and how it is to be done. Management, the previous day, often wrote these tasks, so that the worker would come to work and have their tasks handed to them. Braverman referred to this principle as the “use of this monopoly over knowledge to control each step of the labor process and its mode of execution” (1973:82).

Through these three major principles of Taylor’s work, modern management ideals were developed and influenced the way in which American industries operated in the early twentieth century. One major effect of these principles was the need for a more complex management system. The new management was comprised of individuals with expertise in very specific areas of work within the management structure. Taylor advocated for planning departments that would take care of the work associated with creating the daily tasks for workers. Establishing planning departments concentrated the thought behind labor into one specific area and with a select group of men who were specially trained to address these issues. Additionally, this change in management ideas opened the way for engineers to enter the management sphere. Taylor’s principles mixed with the changes occurring in the structure of business and management created a need for technical expertise that the professionally trained engineer could fill (Braverman 1973).

Christopher Schmitz (1986) explained the ways in which the rise of the corporation infiltrated extractive industries. He claimed that from 1870 – 1930, copper turned away from previous small-scale practices and became large-scale corporations. He also claimed that the growth of the corporation in copper was driven by "a series of geological and technical considerations" (Schmitz 1986:393). This new growth in the United States came with the 1869 tariff that increased duties; after this many companies, especially those of the Lake Superior copper mines, experienced immense profits which were no doubt aided by their status as domestic suppliers.

Much of this growth, at least in the late nineteenth century, was attributed to mergers with other companies. However, by the twentieth century, merger was not the only viable option for growth. Although the profits of the copper companies in the United States were quite large up until 1930, Schmitz argued that merger was not the only way in which companies controlled the market. He claimed that the practice of mining leaner ores from larger deposits allowed the market to expand and grow; however, the important factor in this argument is the subsequent development of new technologies that make this practice profitable. The implications of this, according to Schmitz, were that as copper mining continued throughout the twentieth century, ores became progressively harder to mine in profitable quantities, which lead to higher capital costs as profits were gained over longer periods of time.

Although these changes were occurring and changing the structure of the mining industry, Schmitz also claimed that good management techniques and long-term thinking allowed for continued success of the copper mines. This meant that corporations implemented a hierarchical management system that "became a source of permanence, power, and continued growth" [15] (Chandler 1977:8). Long-term planning also allowed companies to stay afloat in the industry because they were able to continue to acquire new properties and expand their business to remain a viable company. Schmitz contended that these factors were what drove the copper industry through the sixty years from 1870 – 1930.

Kathleen Ochs (1992) discussed the specific role of the engineer in the management of the mining industry. She used the use the Colorado School of Mines (CSM) as a case study to discuss the professionalization of the mining engineering profession from the late 19th through the 20th centuries. In this, Ochs also discussed the way in which management techniques and organizational changes occurred later in extractive industries than in other industries. Hard rock mining did not require the automation and rationalization of work like other industries, which meant that industrialization and changes in management organization did not surface until later. During this time, there was also a shift in who occupied different jobs. For example, mining captains and foremen were no longer apprenticeship-trained men, but instead were college-educated mining engineers.

Ochs stated that there were four stages in hard-rock mining in the United States. In terms of the Copper Country, the latter two of the four are the most important. Ochs claimed, "during the first wave of industrialization (1880s/1890s to 1930s), college-educated mining engineers gradually took over control of productions, automated tools were introduced, and business organization began to change" (1992:282). Then, after World War II, "mining engineers became established, automated mining systems became

[15] Quoted in Schmitz 1986:405

more common, and a more complex corporate system…emerged" (1992:282). The transition between stages represented changes that were related to the changing needs of mining in the United States. As mines grew deeper, technology advanced, and companies grew, the need for a different type of managerial structure, and a professionally trained person to carry forward this structure, became necessary. When mining engineers first started work at a mine, they often worked their way from the lower ranks of the workforce, sometimes starting out as miners, to higher positions such as assayers, surveyors, and mine captains. These engineers also, on occasion, became general managers or superintendents of mine locations. The complexity of the system also created new administrative positions, such as those in research and development and strategic planning.

Ochs stated that as mining engineers began to replace apprenticeship-trained miners, they were also "taking over supervisory positions and fulfilling the new managerial functions of intermediating between miners and the company" (1992:288). During her study of the CSM Alumni Association Files, Ochs discovered that many college-educated mining engineers did not deem themselves successful, nor did their peers deem them successful, if they could not manage other people. One 1895 graduate said, "It is here presumed that any mining school graduate completing the mining course expects to become manager of a mining property either of his own or some other ownership. Later he may find that his inabilities to handle men successfully may relegate him to the technical staff of some mining companys [sic] or institution" (1992:293). Through this statement and those of other CSM graduates, Ochs determined that mining engineers did not believe that their technical duties were as important as their ability to manage workers.

Additionally, as mining engineers began to enter managerial positions, the financial and accounting aspects of mine management shifted. Many engineers were first placed in charge of accounting procedures, with tasks such as estimating tonnage and ore values and researching and ordering mining equipment and supplies. They also looked for other cost-saving alternatives involving new technologies. Different from other industries, mining engineers did not look to change the labor force, but instead change the methods of the labor force in order to create a more efficient, cost-saving operation (Ochs 1992).

From a slightly different point of view, Mauro Guillén addressed management organization from a technological and model-oriented perspective. Guillén discussed the way in which adoptions "of models or paradigms of organizational management" did not "follow from their scientific credibility" and were not "solely determined by economic and technological factors" (1). If an industry was not receptive to changes, then the industry would not adopt those changes. Guillén distinguished between two types of management, the "intellectuals" and the "practitioners." The former were "the elite, self-selected group of spokespeople, opinion leaders, philosophers, or apologists of the managerial class," while the latter "work for large and small firms" and "express their ideas by acting" and "implementing policies" (Guillén 1994:4).

Guillén (1994) referred to scientific management as the change in question. He defined scientific management as an ideology that looked to increase efficiency throughout the company's operations. This involved both management and nonmanagement and played off stereotypical views of the employee and employer that dominated early twentieth century industry. In the case of the employee, scientific management addressed employee idleness, laziness, and wastefulness, while it also addressed employer greed and lack of control (Guillén 1994). Scientific management was created to address perceived issues in the workforce, but had the potential to actually create new issues either related to those previously perceived or to the process of implementing scientific management ideas into the workforce.

Guillén then defined what was an organizational problem with three basic answers – “structural-economic changes,” “international pressures or opportunities,” and “labor unrest” (1994:21).[16] Each of these was what Guillén determined as perceived problems by the employer, not the employee. He stated that management, and engineers, created the problems and through scientific management techniques tried to “fix” them. They used the idea that science is neutral and thus their efforts to control the employees were rationalized (Guillén 1994). This was especially true in times of labor unrest when employers attempted to solve issues through the implementation of new ideas that did not necessarily address the problem.

Login Hovis and Jeremy Mouat (1996) further emphasized the role of the engineer in management and change in mining. They focused on the professionalization of engineers as a catalyst for change in the management of mining industries, and as a factor that deskilled the previous, apprenticeship-trained miners’ work. The authors

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[16] Guillén’s list includes: “1. Structural-economic changes, including bureaucratization, separation of management from ownership, increases in size and complexity, and within-firm diversification of product lines; 2. International pressure or opportunities, i.e. those resulting from international economic, political, and military competition among nation-states; and 3. Labor unrest, i.e. challenges to managerial authority” (1994:24).

claimed that, by 1930, the role of the mining engineer had become the most important factor in the success of mine operations – not the introduction of new technologies. Login and Mouat stated that labor historians of the late twentieth century tended to diminish the roles of any other factors beyond technological change. They stated that the real issue of economic change in mining was “the rise of mass-mining practices” (432).

Instead of focusing on the changes in mass mining in the early twentieth century, instead Hovis and Mouat focused on mechanization prior to 1900. They claimed that the mining engineer had one objective, which was to “reorganize mining to achieve greater levels of production and productivity” (Hovis and Mouat 1996: 433). This created a shift from focus on the individual miner to focus on the group. Though in both situations a hierarchy existed, the hierarchy of the latter was more structured and assigned workers to specific tasks that focused more on quantity of output rather than on quality of output.

Unlike other industry management shifts, this reorganization did not occur with the introduction of new technologies, but rather with changes in the overall system of worker and technology management. Hovis and Mouat further elaborated, “the critical element in the reorganization of the workplace was not the introduction of machinery in and of itself but rather the redesigning of the systems in which workers and machines operated” (1996: 434). In the 1880s, this process began to appear in copper mining, but was not very influential until after 1900. A new generation of mining engineers was then able to redefine the mining industry and its practices. This change reoriented the organization of the mine.

Specifically discussing the Copper Country, Hovis and Mouat stated that, “Prior to 1880, the Lake District of northern Michigan dominated North American copper mining, reflecting the presence there of ores bearing primarily native copper and thus requiring minimal processing – basically simply separating the native copper from the waste rock – to yield a final product" (1996: 436). This differed from the open pit mining techniques and the nature of copper in the American west, a process that proved to be more cost-effective than the underground mining of the Copper Country. This meant that underground mines had to shift methods of mining in order to compete with open pit mining. Further, the authors stated, "Mining in Michigan and elsewhere was a more complex operation by the time that lode mining was established along the western slopes of the Rocky Mountains after 1860" (1996: 437).

The cost-saving measures introduced by mining engineers in the early twentieth century eventually led to cost-saving production techniques that, much like in other industries, lowered the number of mining jobs available. The authors showed that, prior to 1917, the ratio of mine workers to mine output fluctuated in relation to each other – essentially the ratios were the same. However, from the end of WWI until 1930, mine output continually rose while the number of workers drastically declined. This affected all areas of the mining operation. Not only were there fewer workers, but the types of workers shifted as well. No longer were workers expected to know how to complete various tasks, but instead were workers skilled in one task only, similar to the assembly line workers in other industries.

Unlike mining in the American west, the mining companies of Michigan's Copper Country hired workers on a contractor basis, not a wage basis. They concluded that the contract basis created faster workers who required less management, which meant less cost for the company. After 1900, the western companies began to implement the contractor system and replace their previously used wage system. Under that system, wages fluctuated with the growth or decline of the company. Additionally, mining companies looked to incorporate ideas of scientific management in relation to worker pay. Though ideas of scientific management began to infiltrate the mining industry, it was not until the 1910s that mining engineers began to implement management changes that also incorporated ideas from scientific management but adapted them to fit mining (Hovis and Mouat 1996).

With the gift of hindsight comes the realization of the effects of early twentieth century mine management techniques, specifically in regard to scientific management. Taylor and scientific management became a means to an end for mine management as they worked their mines until the end, in the most efficient way possible. Introducing specialized individuals, like mining engineers, to conduct efficiency work allowed the mines to operate at a higher profit. These new techniques and individuals allowed companies to plan into the future, so as to weather any bad copper markets or other issues without going bust. In the case of the Copper Country, these changes meant that a new era of mining was to take place. In this era, the mining companies faced the challenges of the geological realities and also of the changes that they made regarding their workforce in the first decades of the twentieth century.

The Changing Face of Clerical Work

Adoption of scientific management principles was not the only major shift in the changing role of management in the early twentieth century. Clerical work, long the domain of industrious young men, began to turn into women's work in the late nineteenth century. As business practice expanded throughout the late nineteenth century, so did the need for clerks. Harry Braverman (1973) defined the category of clerical work to include bookkeepers, secretaries, stenographers, file clerks, telephone operators, office machine operators, payroll and timekeeping clerks, receptionists, and typists.

Early forms of clerical work were generally treated as a craft. The basic job of a clerk involved working with documentation that was all done by hand, and was a method taught to apprentice clerks by master craftsmen in their area. The advent of labor saving office technologies, like the typewriter, changed clerical work from something that required apprenticeship, training and skill into a field that required little to no skill, as the machine did the majority of the work. However, as office work grew from something ancillary to management and into a separate labor process, the need for scientific management principles grew (Braverman 1973).

Through this change in clerical work also came a change in office organizational structure. No longer did offices consist of a single open room, but private offices became more common, in which there was little to no supervision. And the head of the office shifted from the skilled bookkeeper to the office manager who represented management as a whole and had clerical and management skills beyond just bookkeeping. As these changes took place in industrial offices during the late nineteenth and early twentieth centuries, there was also a proliferation of various types of business and management schools that offered coursework in emerging, often narrowly focused disciplines like management and accounting (Braverman 1973).

Sharon Strom (1992) addressed management changes from the perspective of gender and specialized education. She discussed the ways in which management changed in the early twentieth century from the business office standpoint and incorporated both the ways in which men's roles were altered and how women fit into the office environment. In her first chapter, Strom described how the ideas of scientific management came to change office organization and the way in which work was done in the office by both male and female workers. Many of these new office workers were educated males who began to create and expand basic business organization into skilled work involving accounting procedures and other administrative work. Although during this time work such as typing and stenography became stereotypical "women's work," some women were able to maneuver successfully through the predominantly male world of the office to gain positions of authority.

One major point that Strom made is that jobs eventually took on gender stereotypes. For years, males performed clerking, stenography, telephone operation, and typing duties. As scientific management ideas began to take hold in industries after 1910, various groups, including women's rights groups and universities, adapted these ideas to create employment opportunities. In these two examples, each did this in different ways. Women's groups often adopted the ideas of scientific management into their way of thinking in order for women to gain successful employment in the office world. Still, many employers believed that women were not suitable for the world of office work beyond clerking, stenography, typing and telephone operation. They believed that it was not in women's "natural" abilities to advance beyond these positions.

At the same time, universities were creating new programs that were specifically aimed at training a new generation of office professionals. As companies grew and more people entered the office workplace, the more confusing and convoluted business management became. This in turn lead to the adoption of scientific management principles, including cost accounting, that paved the way for a different office structure. During the 1910s, there was a shift in terms of what was considered adequate training for an office professional. Along with engineering, new university degrees in business and accounting provided different opportunities for young professionals, who diversified the office environment and structure of operations, creating new departments such as finance (Strom 1992).

World War I was a major cause for change in the office environment. During the war, women were often hired for positions previously only given to men, including low-level managerial positions. After World War I ended, the employment opportunities that women had earned during the war were no longer available, and often, women were removed from the positions they had gained during that time. In the higher levels of office management, men were willing to hire women to work for them, but only on the terms that the women understood that the men were always in charge (Strom 1992).

Changes in education and management were highly influenced by the addition of women into the office space. According to Robert Heilbroner and Aaron Singer (1994), about fifteen percent of women over the age of sixteen were working in 1870, at the beginning of the management revolution, while, by 1929, over twenty-five percent of women were working. In the office environment in particular, in the thirty years between 1870 and 1900, the number of women in the office increased 2700 percent (Heilbroner and Singer 1994:234-235). Though women were working before the 1870s, these positions were often extensions of traditional positions they had at home. By the twentieth century, the composition of women's work changed drastically to accommodate the increase of women in the office environment.

Though many of these new jobs available to women came from the advent of new office technologies, men also felt the effects of the increased number of women. For example, Heilbroner and Singer (1994) stated that males almost completely disappeared from the telephone/telegraph operator position, as it became a stereotypically female profession. By 1907, the number of telegraph operators nationwide was about 80,000, while only 3,500 of these were men (Heilbroner and Singer 1994:235).

Although the composition of the office changed drastically in terms of personnel, technology and management style, women were not as valued in the office environment. Around 1900, women's wages were seventy-five percent less than males in manufacturing industries on average. However, women working in the office environment fared much better in terms of wage discrimination than their female counterparts in more difficult manual labor positions (Heilbroner and Singer 1994).

Changing Technologies in Clerical Office Work

The typewriter was one of the more influential office machines introduced into American business practice. As businesses grew dramatically after the Civil War, the typewriter founds its place in the new office as a particularly well-suited device[17]. Since its introduction into business, women almost exclusively operated the typewriter. Businesses needed to create large amount of records at the lower levels of business that

[17] Hoke listed the factors directly related to the demand for typists as, "(1) the growth in the size and complexity of American firms and the resulting expansion of office staffs, (2) the benefits of adopting the typewriter, and (3) the relatively low wage rates for women compared with men" (1979: 78).

could then be transferred to the higher levels and with this demand came the need for more specialized clerical staff and new technology. The typewriter answered this question and allowed for copies of documents to be kept at the office and allowed for easy duplication of documents for multiple departments (Hoke 1979).

Along with the proliferation of new workers in the office environment came the management's desire to keep costs low. As women were offered and accepted lower wages than their male counterparts, they were more likely to be hired for positions as typists and other clerical work. Men were considered to be more capable of the intellectual processes behind office management. On the other hand, women were "thought to be more sympathetic than men" and were "believed to be temperamentally, physically, and emotionally superior to men for office work" (Hoke 1979:82). Though the wage differentiation existed between men and women, clerical work was much more appealing to middle class women in the late nineteenth century as compared to factory work.

For the middle class woman, clerical work was seen as an acceptable form of employment until one was married, at which time it was assumed she no longer needed to work. According to Daniel Hoke, "lower class employment was associated with lower class morals" (1979:80). Office work was much less stressful than factory work, offered more chances for intellectual stimulation on the job, and left the worker with enough energy at the end of the day to take care of any tasks at home. Also, according to Hoke, the business office was a wonderful place to meet a potential future husband. Most female office workers were, on average, "single, unmarried, and under 30 years of age" (Hoke 1979:80).

As new office technologies helped to change management practice so did changing definitions of positions. Charles Wootton and Barbara Kemmerer (1996) discussed the role of the bookkeeping profession and its direct affects on business organization and management. As part of clerical work, bookkeeping went from a skilled job consisting of keeping financial records and analyzing company accounts, to a deskilled profession comprised almost wholly of the repetitive task of copying information into ledgers. This shift was predicated by the need for more bookkeepers as businesses grew after 1870[18]. The latter half of the original bookkeeping profession split off to become the new, male dominated profession of accounting, while the bookkeeping aspect was predominantly female.

The partitioning of bookkeeping and accounting occurred simultaneously with the influx of women into the office work place. Bookkeeping became a trade while accounting became a profession. Universities began offering accounting programs as part of their growing business curricula and began marketing these programs towards males. However, even with the loss of status of the bookkeeper, it remained a viable and respectable occupation for middle class women for many decades.

Additionally, as the definition of bookkeeping began to change due to the split of the accounting aspect into its own profession, bookkeeping lost more status as its place within the business management hierarchy shifted. Instead of reporting directly to the

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[18] According to Wootton and Kemmerer (1996), this demand for bookkeepers reflected "(a) the industrialization of America, (b) the rise of the corporate form of ownership and the separation of ownership, (c) the rapid increase in the size of businesses and a corresponding increase in the number of records, (d) the geographical expansion of businesses across the nation and the world, (e) the increased complexities of federal and state tax and reporting laws, (f) the increased need for cost controls and records for both accounting and management purposes, and (g) the further development of financial statements" (576.577).

owner or manager of the business, bookkeepers increasingly began to report to the accountant or perhaps the office manager. Bookkeeping's status went from being part of management to part of the vast labor pool that operated under and for management's benefit (Wootton and Kemmerer 1996). This shift in bookkeeping's role in the office coincides with the influx of women into this aspect of office work and speaks to the interrelated concepts of new technology, increased business scale, and changes in the gendered makeup of the business office personnel.

Changing ideas regarding clerical work and the introduction of new office technologies and women into the workplace developed alongside the new ideas of scientific management. As scientific management created more efficient work for laborers, it created a different type of work for the office environment. Paperwork became very important and the need for quick dissemination of information opened a window of opportunity for new clerical technologies and women to fill positions that were previously filled only by men.

Changing Management Ideas in Two Companies in the Copper Country

Much change occurred in industrial management in the early twentieth century. As these new ideas infiltrated industry nationally, how did they affect the Copper Country, in particular Calumet and Hecla and Quincy Mining Company? Were scientific management ideas adopted fully or were certain aspects chosen, if any were used at all? How, if at all, did these companies deal with new ideas, new types of management and office workers and new office technologies? The case studies in chapters three and four will attempt to answer these questions while detailing their operations in the early twentieth century.

CHAPTER THREE

CASE STUDY: CALUMET & HECLA

The Calumet & Hecla Copper Company (C&H) began in the mid-1850s, when Edwin J. Hulbert first discovered the Calumet Conglomerate Lode, near present-day Calumet, Michigan (Figure 3.1). This discovery allowed him to establish the Hulbert Mining Company in 1864, which would later be incorporated into Calumet and Hecla. Upon establishment, the Calumet Copper Company and the Hecla Copper Company purchased land on either side of Hulbert, essentially pushing Hulbert out of the business, assisted through a number of poor business moves on Hulbert's part. In 1867, Alexander Agassiz would take over as president of what would become Calumet and Hecla Mining Company (Bennett 2007).

In 1871, the Calumet and Hecla Mining Company incorporated, combining the Calumet and the Hecla mines. During this decade, Calumet and Hecla was a leading producer in the United States, if not the world, accounting for 52% of the copper output in the United States (Schmitz 1986). C&H corporate offices were located in Boston, Massachusetts, where Alexander Agassiz oversaw the operations of the mine for many years. In addition to the corporate office, C&H had a general office in Calumet, plus a mine office in Lake Linden, Michigan, and two smelter offices, the larger in Hubbell, Michigan and the smaller in Buffalo, New York (Sawyer 1911). Throughout the second half of the nineteenth century, Calumet and Hecla remained the largest copper producer in Michigan. They remained a leading copper corporation into the twentieth century, earning $57,000,000 in 1898, $57,800,000 in 1909, $100,000,000 in 1919, and

$87,000,000 in 1929 (Schmitz 1986:394). The majority of decisions affecting company operations came from within the walls of the C&H general office in Calumet.

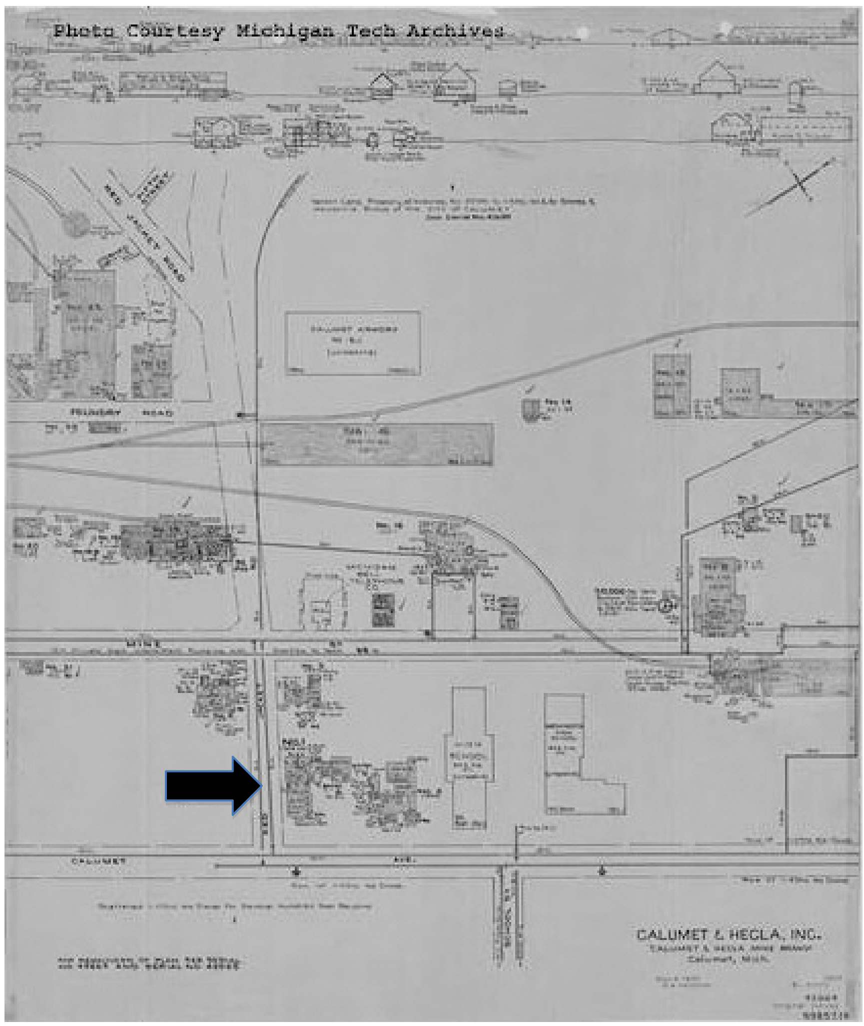

Figure 3.1: Insurance map of Calumet and Hecla, Inc. from 1954. Office indicated by arrow. Image courtesy of MTUA/CCHC, image #: C & H Map 103-B-1954.

Figure 3.2: 1887 General Office of the Calumet and Hecla Company. Image courtesy of MTUA/CCHC, image #:MTU Neg 02687.

The 1887 Calumet and Hecla Mine Office

Planning and construction for the 1887 C&H mine office commenced in the mid-1880s. The original architects were Shaw and Hunnewell, based in Boston, where C&H headquarters were located (Eckhert 1993). Though the building blueprints were completed in Boston, Superintendent Wright played an important role in deciding the details of the building. Little correspondence occurred between Wright and President Agassiz after the initial construction began, perhaps because the job was done in-house, but during the initial planning stages, Wright's opinions were integral to the construction of the structure that now exists. On November 30, 1885, Wright wrote to Agassiz with multiple suggestions regarding materials that would both be practical based on the climactic conditions of the area and would provide some cost-savings for the company.[19] Wright continues, in two separate letters a few days later, to tell Agassiz that mine rock will cost substantially less than brick and, if there was enough mine rock of good quality, even the blacksmith shop could be built of it as well (Dec 2 1885; Dec 4, 1885). Wright's plan was chosen, which led to the unique finish the office still has at the present.

Wright's planning for the office did not end there. Beyond woodworking, his interior suggestions ranged from the best heating system to the best layout of the office space. Wright wrote on December 5, 1885, a week previous, to Agassiz regarding even more details for the interior, including heights for the stories and the organization of the offices and their sizes.[20] A week later, in a December 14, 1885 letter from Wright to

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[19] November 30, 1885, Wright wrote to Agassiz, "I have no doubt tho [sic] that the stone wall would be the cheapest, as brick here is pretty expensive, while stone costs nothing but the hauling. Our mason's foreman says he thinks they would lay up a two foot stone wall, faster – therefore for less money, than they could a 16 inch brick wall.
I will try to get at actual Figures as to cost, they may not be exact, but will I think be sufficiently so for our purposes.
A building of our mine stone, I think could be plastered by [indecipherable] on to the wall without any studding, but of brick this could not probably be done without making a hollow wall – making it more expensive I presume.
I propose to finish with hard maple floor; with dado or wainscot of Norway pine, and Birdseye maple for mopboard and chair rail. Pine doors, with perhaps Norway or Birdseye for outside casings of door and window frames.
Will the flat roof, covered of composition of which you speak, be thoroughly water tight when covered with a heavy depth of snow, with ice frozen onto the eaves which will dam up the water and [indecipherable] it back under the snow. Our best shingle roofs are almost sure to leak under these conditions although they are generally built with a steep pitch?
In addition to wash basins and water closets, there should be abundant wardrobes for hanging coats, etc. or rather coatrooms" (MTUA/CCHC, Collection MS-002, Box 109, Folder 001).

[20] December 5, 1885 Wright wrote to Agassiz, "It seems a very complete arrangement and I really have few suggestions to make that you will consider worth attention.
The two main stories seem to be 10 and 9 feet in height – would not 11' and 10' be better in a building as large. Those would certainly not be high ceilings and would get windows up where the lights would perhaps be better?
The Engineers [sic] room is larger than required, and, as most of the small rooms could be given up, the one on the west side, had better often [indecipherable] hall instead of Engineers [sic] office, and be used for General Office store room.
The stairway to [indecipherable] in roof is not needed and that space had better be thrown into the room marked "store r" making a good additional chamber if needed.
Do you intend to make the partition wall of brick, if so of common brick?

President Agassiz, Wright almost demands from the architects what is needed for this office, most likely based on the climate of the area.[21] Wright's suggestions translated into the building as it was built during 1886. By July 1887, the office was occupied, though the second story was not yet completed.

Calumet and Hecla used the mining office located at the corner of Red Jacket Road and Calumet Avenue from the time of its construction in 1887 through the company's closure in 1968 (Keweenaw 2001). Upon construction, the building stayed relatively true to plan. Post-1968, the office was occupied by Universal Oil Products Company (UOP), who bought C&H in 1968, until 1979, when they sold the office to Calumet Medical Clinic, which operated there until 2000. This latter occupant made many changes to the interior of the office, so that now, little remains of the original configuration. In 1992, the clinic donated space to the Keweenaw National Historical Park (KNHP) for use as their headquarters. Since December 2000, the National Park Service has owned the structure, which now serves at the general headquarters for KNHP (Keweenaw 2001).

The 1887 general office building of Calumet and Hecla went through multiple stages of addition. During the building's first twenty years, three additions were made (Keweenaw 2001). Originally, the structure was rectangular in shape, with two floors, an attic, and a basement. The structure was made of local, rough-faced mine rock, with

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The ground we intend to build on is low and the basement – at least half of it will probably be a good dent more above ground than shown in the sketch" (MTUA/CCHC, Collection MS-002, Box 109, Folder 001).

[21] December 14, 1885, Wright to Agassiz, "If you will send a sketch of the roof plan for new office as soon as ready it will enable us to get the stuff seasoning. It will be changed some if the gabled one is adopted, and it certainly seems to me much the best. Will the architect show heating flues on the plans – i.e. for hot air. Which is it best to use, hot air furnaces or steam. Both have their advantages, high I should think another which that two large hot air furnaces might be best and simplest. If so I wish Mr. Shaw would include the flues in the plans & specifications, bearing in mind that there should be abundant capacity" (MTUA/CCHC, Collection MS-002, Box 109, Folder 001).

brick on the building edges and around the windows, a side gable slate roof, and measured seventy feet by forty-six feet, with the pay office attached to the north end. This pay office measured thirty feet by ten feet and had two doors for mine workers to enter and exit, as well as another door on the west side, presumably for the pay clerks. The majority of the windows on the structure were six-over-two double-hung sliding sash (Keweenaw 2001). The front door was located on the west side, though the main street was on the east side of the building. This door was centered on the building with three steps leading up to it. The front of the office contained two sets of three six-over-two windows on either side of the doorway. Each window had a slightly curved lintel. The door was nestled between two smaller windows, also with curved lintels. The second story windows imitated the first story windows in that there were two banks of three windows directly above the first floor windows, though these were smaller in size, and there were two identical windows above the two flanking the door.

The east side almost exactly matched the west front side. In total, the windows were broken up into three sections on each of the two stories. Like the front, the windows to the left and right of the center were banks of three six-over-two windows with curved lintels. The main difference on this side is that there was no door, so instead, there were three windows with curved lintels, which were very similar to the banks of three, except these windows were separated. The second story windows resemble the first story windows in that there were three windows, separated, but these were slightly smaller in size.

The north and south ends were not symmetrical to each other, mainly because of the pay office attached to the north. On the north end, the windows almost looked staggered. There was a small attic window. On the second story, there were two arched lintel windows that appeared to almost flank the attic window. The first story had two windows that sat on either side of the pay office extension. All three sets of windows looked as though they created two sides of a triangle on the building. The pay office had two doors, with two windows between them. The south end contained a different configuration of windows. There was a small attic window. Directly below this window, on the second story, was a large, arched window with two small windows below it on the first story. On either side of the first and second story windows were single windows. There were also three small windows, directly under the first and second story windows, for the basement.

In 1899, a small wing was added to the east side (Figure 3.3). According to the Keweenaw National Historical Park, no documentation exists regarding the addition of this small wing. Later, this would become the large east wing that is still present on the structure. This addition was a one-story wing with pyramidal roof. It resembled the rest of the building by using the same stone masonry and brickwork. Additionally, the windows were also similar to the original structure and mostly resembled those on the center of the east side. These new windows were smaller in size (Keweenaw 2001).

Figure 3.3: C&H general office with fence plus what appears to be scaffolding on the east side for either 1899 or 1909 addition. Image courtesy of MTUA/CCHC, image #:Nara 42-228.

A more substantial addition was made to the north end in 1900 (Figure 3.4, Figure 3.5). The pay office was replaced with a two-story addition, with an attached pay shed. The two-story addition was completed of the same masonry and brick as the rest of the building. The main difference in the new masonry addition and the rest of the building was its size; it was not as tall or as wide as the rest of the office. This addition was twenty-two feet by thirty feet. The one-story pay shed was a completely different construction. Originally meant to shelter workers as they waited for their pay at the pay windows, it was constructed of corrugated metal with a cement floor. On the walls were long banks of windows, each six-over-six, that extended around the pay shed. This pay shed was slightly larger in plan than the masonry addition, at forty-five feet by forty feet (Keweenaw 2001).

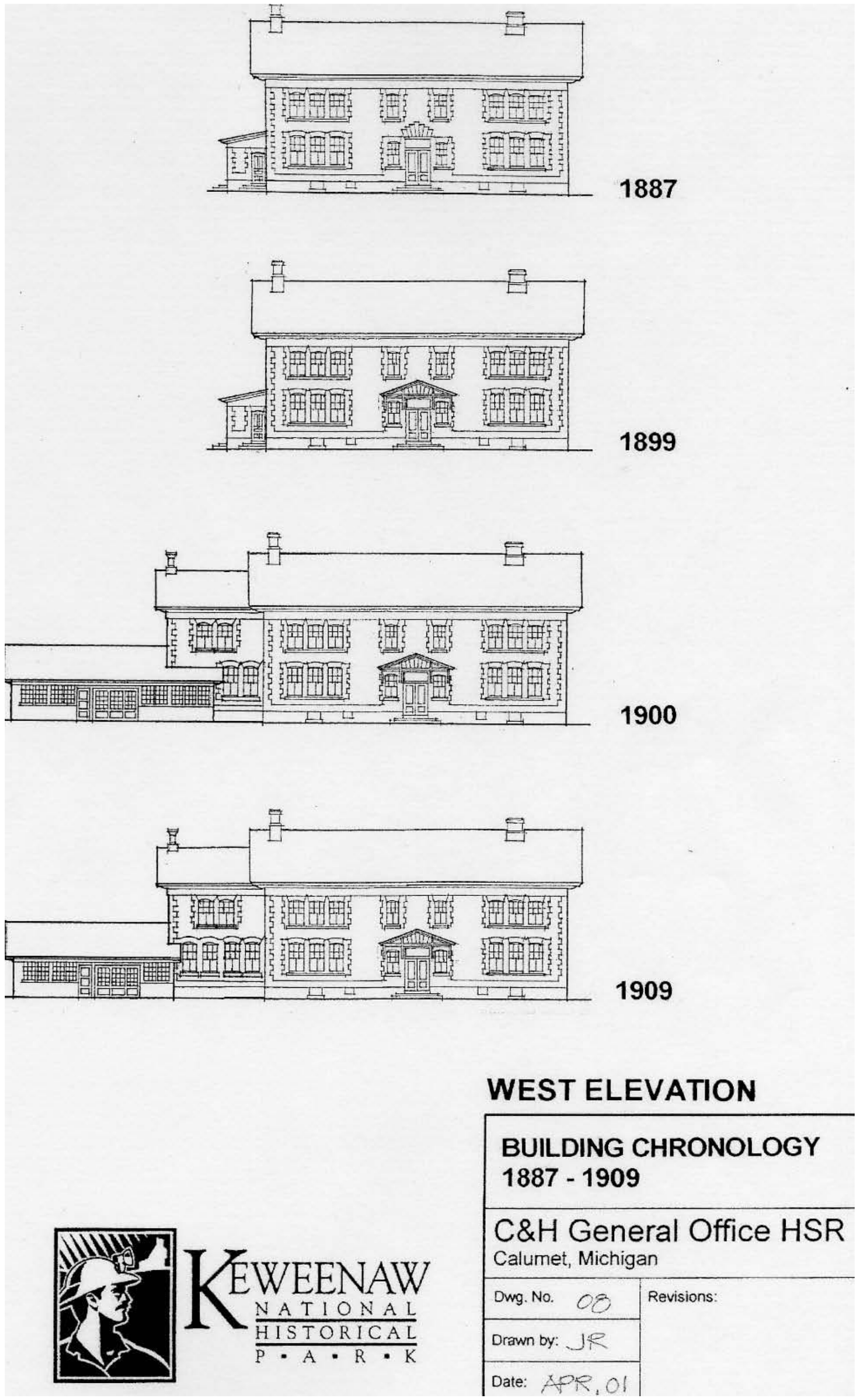

Figure 3.4: C&H office building chronology showing west elevation additions made from 1887 – 1909. Nicely shows changes made to the north elevation through time. Image courtesy of Keweenaw National Historical Park, Calumet & Hecla General Office Draft Historic Structure Report.

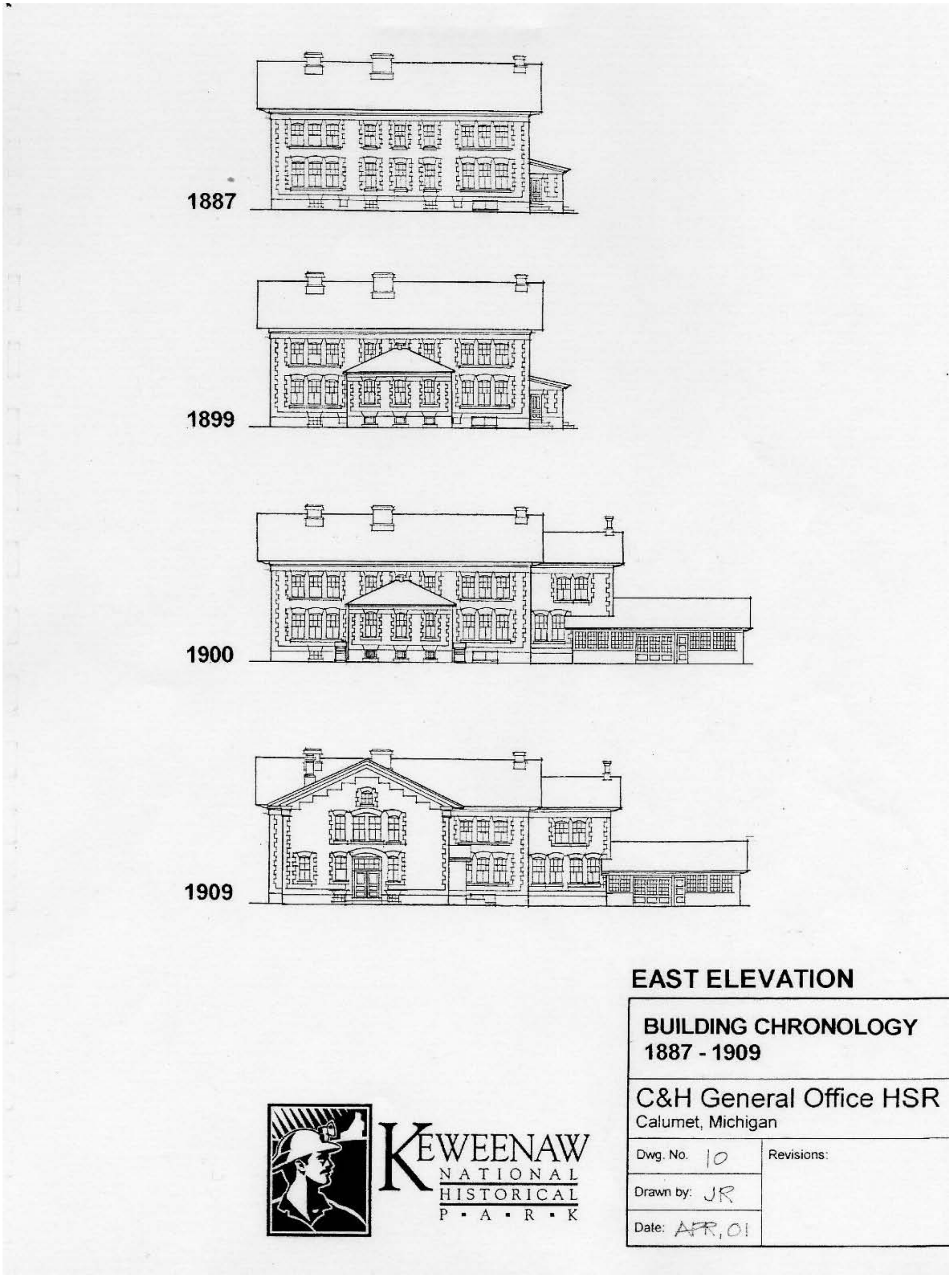

Figure 3.5: C&H office building chronology showing east elevation additions made from 1887 – 1909. Nicely shows changes made to the north elevation through time. Image courtesy of Keweenaw National Historical Park, Calumet & Hecla General Office Draft Historic Structure Report.

The last major stage of construction occurred in 1909 (Figure 3.6, Figure 3.7), when C&H built the new east wing. This wing was sixty-nine feet by forty-six feet and was considered the most extensive construction C&H did for the office, beyond the initial build. The 1900 east wing was partially removed, though it appears as though the north wall was incorporated into the new construction (Keweenaw 2001). The new wing also had a front gabled slate roof. Window construction remained very similar to the original foundation, though the windows varied in size and were not banked. The east end windows were not symmetrical. A small window was present above a bank of four windows above a door. The door has two windows flanking it on either side, with one more window to the south.

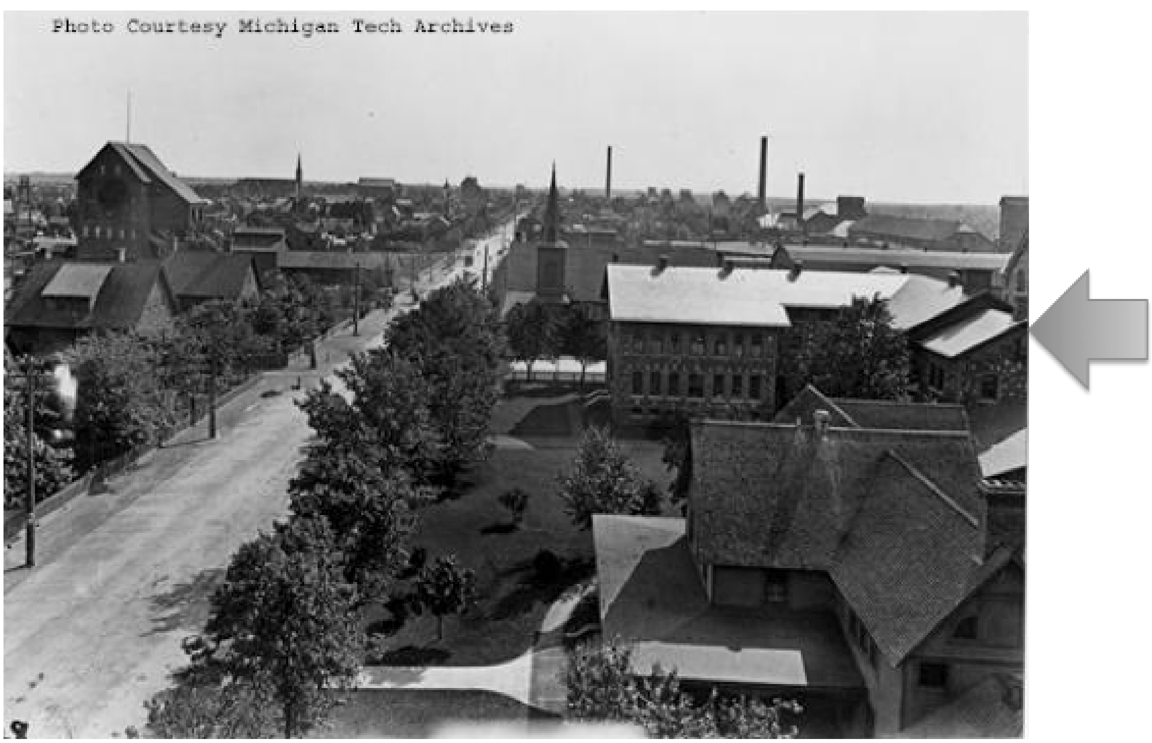

Figure 3.6: Image of Calumet and Hecla property, including additions to the mine office. Image looking south from Calumet High School. Arrow points to location of office. Image courtesy of MTUA/CCHC, image #:MS003-007-001E-05.

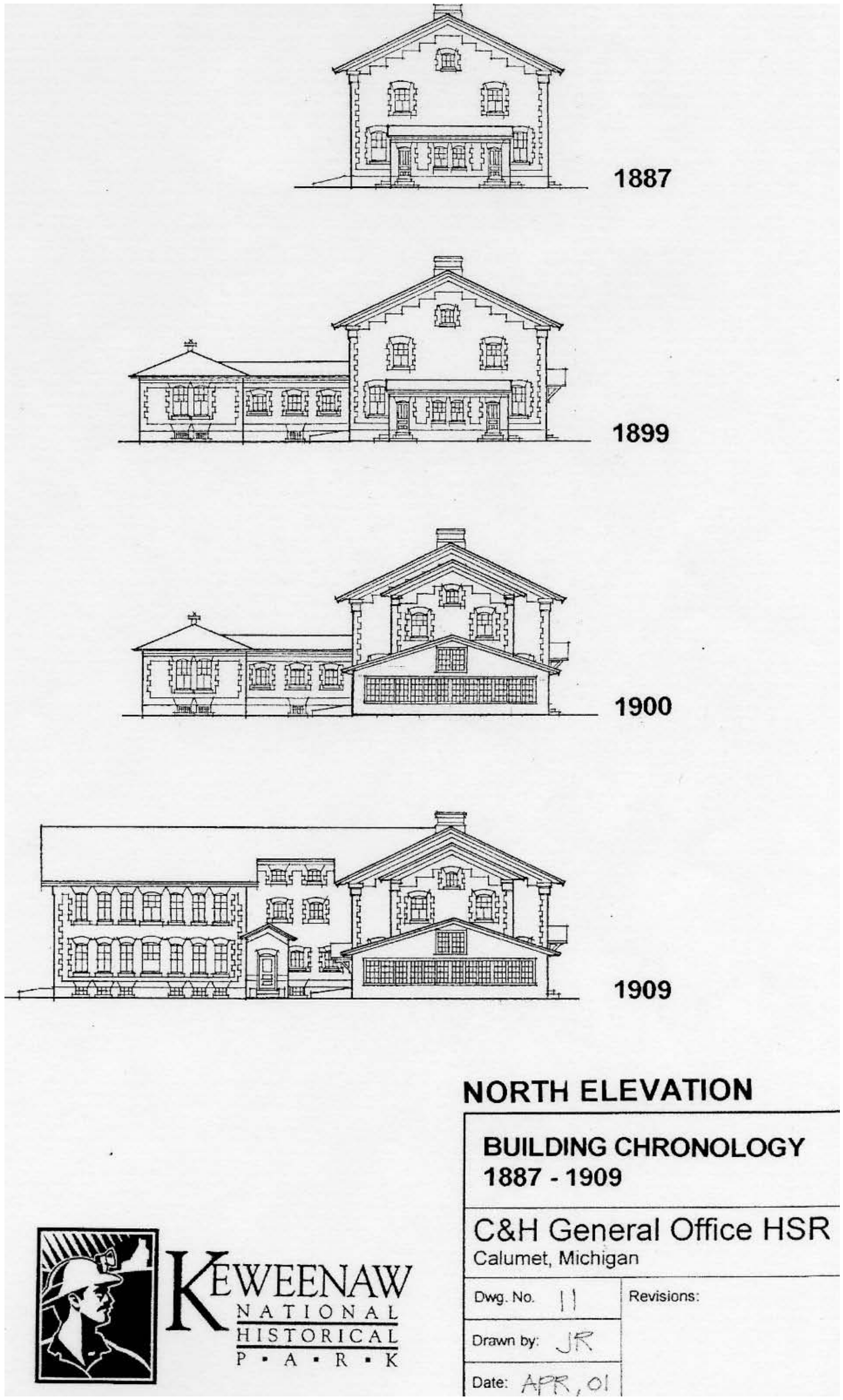

Figure 3.7: C&H office building chronology showing north elevation additions made from 1887 – 1909. This elevation well documents the additions made to the east elevation throughout time. Image courtesy of Keweenaw National Historical Park, Calumet & Hecla General Office Draft Historic Structure Report.

The interior went through multiple modifications in the structure's initial twenty years as well. The changes that occurred to the exterior also affected the interior arrangement of space. The first east addition gave the building two additional rooms, labeled "office" and "waiting room," in the one-story 1899 addition. These two rooms were, respectively, 24' x 32' and 11' x 24'. As the employee force at the mine grew so did the need for greater office facilities. The second addition in 1900 expanded the office to the north and, gave "an extra room for the counting room department and an extra room in the engineering department on the second floor" (Keweenaw 2001:12). By the end of the decade more expansions occurred at the office. In 1909 the east wing was modified, adding a second floor and expanding the first. This addition was the only one that was not designed internally by C&H, but instead was designed by the firm of Charlton and Kuenzli, who had offices in Marquette and Milwaukee. The first floor of the last addition consisted of office suites for the general manager and other employees, and a large room with adjacent smaller rooms for the drafting department. This addition also included an attic and basement space (Keweenaw 2001).

One major change to the organizational structure of the office occurred in 1944, when C&H expanded its office operations into the library building across the street. What had previously served as a bathhouse and library now became office space for employees. In this building were offices for "the company president, chief geologist, research director, legal experts and stenographers" (Keweenaw 2001:14). This change could have occurred based on expanding operations, but, at the same time, the move could have been caused by the influx of geological and engineering staff to the main office building, as their building burned down a few years previous.

C&H Management: The MacNaughton Years, 1901 – 1941

James MacNaughton served as general manager of Calumet and Hecla from 1901 through his retirement in 1941. Though born in Canada, his family moved to the Copper Country when he was young. He studied engineering at the University of Michigan and came back to the Copper Country to work in the mining engineer's office as a draftsman. In 1889, MacNaughton left the Copper Country, only to return in 1901 as general manager of C&H[22]. MacNaughton was with the company through the successful years of the early 20th century and rode out the tough World War I and depression years as well.

Entering the second decade of the 20th century, C&H had remained profitable, but worked hard to lower their costs of production. It was largely believed that the older mines in the Copper Country, including C&H, had already seen their best years of production (By the Way 1911). J.R. Finlay (1911) wrote that, as the mine had been largely developed, working out the remaining ore would allow C&H to remain profitable until the ore dissipated.

C&H's use of efficiency engineers was prominent in 1912 as operations were altered to reflect changing management ideas of efficiency. Early in January 1912, Albert Mendelsohn, an engineer at the Superior Copper Company, a subsidiary of C&H, wrote a document regarding Scientific Management at a mine site. In this document, Mendelsohn addressed the needs of management to help realize a more efficient workforce and gain maximum efficiency from each worker. He stated that the company's role was to put the system in place by assigning foremen to create tasks for each worker. In addition to this, Mendelsohn recognized a need for more clerical work as

[22] "Men of Progress," 1900. Copper Country Vertical File: MacNaughton, James. Michigan Tech Archives & Copper Country Historical Collections, Michigan Technological University, Michigan.

the daily tasks would need to be typed. Mendelsohn came to the conclusion that the workforce was fragmented in terms of knowledge because the workers were not apt to share their knowledge with their fellow workers – lest those workers know more than he who shared. By implementing scientific management principles, Mendelsohn believed that each worker would know the same as his peers and thus when integrated with efficiency studies and the "best" possible way to operate, the mine would reach a new level of efficiency[23].

MacNaughton's management organization was very hierarchical, with him at the top, followed by the general superintendent, and the superintendents of each site or subsidiary company. This strict hierarchy of management often put MacNaughton into a position in which he appeared as though he was operating the company to the detriment of the workforce (Figure 3.8). The new implementations of efficiency work created problems because while MacNaughton needed to operate the company at a profit, he also needed to address the realities of the site and the demands of the workforce. During the strike in 1913 and 1914, MacNaughton was often accused of completely ignoring the demands of the Western Federation of Miners. This move was commended by corporate management and the shareholders[24], but created tensions between mine management and the workers.

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[23] Albert Mendelsohn's document dates to January 22, 1912. MTUA/CCHC, Collection MS-002, Box 212, Folder 158.

[24] In the December 31, 1913 annual report, in reference to the strike and the Western Federation of Miners, the report noted that, "Your [MacNaughton's] management has felt it to be its duty to its loyal employees, to the community and to its stockholders to refuse to have any deadlines with this organization and to refuse to employ its members" (MTUA/CCHC, Collection MS-002, C&H Annual Reports).

Figure 3.8: Interior of James McNaughton's office, ca. April 1918, where he made all of the important company decisions. Image courtesy of MTUA/CCHC, image #: MS042.032.999.F198B.

After the strike ended, many workers looked at MacNaughton almost as the enemy of the workingman. In 1915, an article in the *Miner's Bulletin* called out MacNaughton for his assumed lack of moral responsibility to the well being of the workforce and community [25]. The article berated him for ignoring the mediation intervention by the State of Michigan and blamed him for deaths. His work creating a more efficient, more profitable mine was interpreted as an affront to the workforce at the mine.

By 1915 C&H had developed a finely tuned efficiency system throughout their operations. Underneath the general manager were many superintendents who ran various

[25] "James MacNaughton." Miner's Bulletin, 1915. Copper Country Vertical File: MacNaughton, James. Michigan Tech Archives & Copper Country Historical Collections, Michigan Technological University, Michigan.

sections of the operations and headed subsidiaries. With all of the subsidiaries C&H controlled, it was often hard for a concrete system to work without flaws. MacNaughton worked to smooth out the inefficient work of the operations. In January 1915, he sent a letter to each superintendent, providing him with directions on how to purchase new items. MacNaughton realized that communication was essential to efficient and cost-saving management[26]. He left some of the control in the hands of the superintendents, but added the oversight of the Purchasing Agents. In this way, MacNaughton was able to keep some semblance of control over the operations, while allowing his superintendents some freedom in their decision-making (Figure 3.9).

[26] On January 5, 1915, MacNaughton wrote to his superintendents, “I find that in many instances, the Heads of Departments, or superintendents of Subsidiary Companies conduct correspondence with outside firms that eventually lends to the placing of an order, by one of the companies, for material or supplies of some character. The order goes through the Purchasing Agent for the mine in question, but the Purchasing Agent’s Department has none of the preliminary correspondence that led up to the placing of the order. This leaves the Purchasing office without valuable information that is frequently required, and at times it is almost impossible to collect the information that precedes the actual placing of an order. In order to avoid this difficulty in the future you are requested, when conducting such correspondence, to formulate your letter as formerly, but to send it to your Purchasing Agent, together with carbon copy of same, that he may sign it before it is sent out. The reply to such correspondence will come, with carbon copy attached, to the Purchasing Agent, who has instructions to mail the original to the party originating the correspondence.
After the order has been placed there may be correspondence pertaining to details that it is not necessary to have to go through the Purchasing Agent, but if such correspondence modifies the terms of the contract in any way, it of course, should go through the Purchasing Agent, to the end that he may have a record of all such modifications” (MTUA/CCHC, Collection MS-002, Box 048, Folder 553).

Figure 3.9: Completing paperwork, early 20th c. Image courtesy of MTUA/CCHC, image #:MS042.016.053.1024.

Ocha Potter, the head of the efficiency department and superintendent of the subsidiary Superior Copper Company, provided MacNaughton with many suggestions regarding efficiency work and how to distribute the information to the workforce. Potter was a large proponent of printed and published bulletins for workers. He wrote to MacNaughton in May 1915, suggesting that MacNaughton print out occasional "Efficiency Bulletins" for the various superintendents of C&H's subsidiaries[27]. Potter also pushed MacNaughton to develop efficiency departments at other mine sites and subsidiary companies to establish the most efficient working conditions possible[28].

[27] On May 26, 1915, Potter wrote to MacNaugton, "Would it not be worth while to send out an occasional "Efficiency Bulletin" to the various superintendents… It would perhaps create more interest in this work and also avoid some of the critisicm [sic] we have several times met with that we are not distributing our information enough" (MTUA/CCHC, Collection MS-002, Box 048, Folder 568).

[28] Potter wrote to MacNaughton on June 19, 1915, "I would like permission to establish an efficiency department in the conglomerate branch. I am satisfied that there is an increase of 50% possible with present air pressures by using 7/'" Carr bits. I wish to put two machines on this steel and bit and use one efficiency man with them for an observer" (MTUA/CCHC, Collection MS-002, Box 048, Folder 568).

Potter recognized that each site was different and that the efficiency tasks would need to be altered from other sites to fit the needs of that particular site.

Additionally, in 1917, Potter created a set of instructions to “Efficiency men” at the mines and sent them to MacNaughton for approval[29]. Potter’s instructions included when, where and how to begin inspection of the site. He listed questions of which the men should ask the workers and created a system of which the efficiency men should document their findings. In addition to these reports, each man was to keep a general record of the site over time. These instructions were detailed down to the color of ink that should be used when noting different items. The efficiency work of the early 1910s, coming mainly from Potter’s forging ahead with scientific management principles, allowed C&H to operate more efficiently throughout World War I and into the 1920s with little trouble maintaining profits, though C&H was not immune to wage cuts and labor shortages.

Though the effects of low copper prices and the Great Depression made operating the company difficult, the culture of the general office was one of camaraderie and efficient operation to reach the company’s goals. By this time, the office environment was comprised of a mix of men and women, working to meet various goals throughout the specialized departments in the office. One of the first female clerks hired in the office, Hazel Maneer, performed so well that from then on, C&H recruited young women to work in the office at a greater percentage than men, according to Evelyn Glesener, a clerk in the general office from 1922 through 1933. Glesener also noted that MacNaughton, the “devil of the workforce,” often treated his office staff to occasional

[29] MTUA/CCHC, Collection MS-002, Box 048, Folder 591.

picnics. MacNaughton would give the staff an afternoon off and take them out to places like Gratiot Lake or Point Mills, where he would treat them with a meal, prepared by the chef from the Miscowaubik Club. Glesener noted that C&H treated its female employees quite well. By the 1920s, there were at least ten to twelve female office workers working as clerks or operators within the office[30].

As copper prices continued their decline into the 1930s, C&H, however, remained optimistic about their future mining prospects. In 1931, the *Engineering and Mining Journal* proclaimed that C&H still had fifteen years worth of ore in their upper conglomerate area. C&H predicted the same, given the slow ore removal process and the amount of remaining ore in in Calumet. They closed certain shafts that could not operate profitably for the company during the slow years (Lankton 2010). They strategically planned where to ramp up production, while leaving areas with less ore, like the Osceola shafts, and reclamation of stamp sands for use when the copper market picks back up (*News of the Industry* 1931d: 377). The high copper yields coupled with the ability to keep production down at lower yielding parts of the operation helped C&H to remain profitable through the rough years of the Great Depression.

In 1932, like other mines in the area, C&H suffered from the low price of copper. Though they did not shut down operations entirely, they were forced to make concessions. Some operations were shut down, while others saw a reduction in hours worked and men employed[31]. By 1935, C&H began to pull through and employees saw a

[30] Evelyn Glesener. Interview by KNHP, July 9, 2001.
[31] December 31, 1932. MTUA/CCHC, Collection MS-002, C&H Annual Reports.

general increase in wages as operations slowly returned to pre-depression conditions[32]. However, in 1939, mining ended on the once-profitable Calumet Conglomerate lode (Lankton 2010). MacNaughton retired from his position as general manager in 1941, after operating C&H through the Depression. By that point, operations once again evened out, no doubt aided by the push from the start of the Second World War, with the company employing 1,538 employees, compared to 1,442 in 1940, and providing a company-wide pay increase for employees[33] (Lankton 2010).

MacNaughton's managerial legacy extended after his death. C&H still hired efficiency engineers in the late 1940s. John Lasio, a mining engineer hired as an efficiency expert, began working for C&H in 1947. He worked directly for the mine manager and spent much time in the office working on multiple projects, depending upon perceived needs at the moment, though everyone except the general manager was expected to work underground at some point[34]. Working underground meant that the engineers had first-hand experience with the workings of the mine and gained a distinct knowledge about the mining process. In the 1950s, C&H operations were still using elements of efficiency introduced and incorporated by MacNaughton in the early twentieth century. Many of these elements were then understood as what they were – cost-saving measures. In regard to the organization system of operation, Ray Franz, a cost accountant at C&H in the 1950s, noted that, "we had a real refined system…

[32] December 31, 1935. MTUA/CCHC, Collection MS-002, C&H Annual Reports.
[33] December 31, 1941. MTUA/CCHC, Collection MS-002, C&H Annual Reports.
[34] John Lasio. Interview by KNHP, September 11, 2003.

everything was done by minutes.[35]" Franz attributed much of the efficiency involved to the use of office machinery that did the job for the office employees.

Scientific Management at the C&H Mine Office

James MacNaughton, a college-educated engineer who put much faith into his college-educated workforce, implemented many scientific management changes within the office. C&H hired efficiency engineers just prior to the start of the 1910s. During that initial period, following in the footsteps of the manufacturing industries where scientific management principles first took hold, C&H did time and motion studies of its workforce and of its machinery. MacNaughton took the new scientific management principles seriously and in 1912 hired an efficiency engineering firm to study its machine shop performance (Lankton 1991).

Inside the office, the growth of the building itself led to many changes until 1909. After that, MacNaughton's scientific management of the space relied heavily on the reorganization of people and departments therein. As new, more specialized departments were created, the interior layout of the office shifted. Much of the work inside the C&H office was conducted with new office machinery, no doubt introduced by the new engineers at C&H, to create more scientific, efficient work in the office. Work was detailed down to the necessary movement through the building to get jobs from one department to another. In the case of the check printing process, the printing machines were all in the basement, while the accounting services were on the first floor, near the pay windows. Though on different levels, the amount of time it took to get from the

[35] Ray Franz. Interview by KNHP, October 3, 2003.

printing room to the accounting room was not that far. Later into the twentieth century, as the accounting department moved to the second floor, the check printing operations moved with it.

The scientific management ideas implemented by MacNaughton and his efficiency engineers in the early twentieth century completely reconfigured the meaning of the office in terms of space and work. Detailed management techniques meant more specialized departments taking care of a single step in the process and moving on to another department in another section of the building. This level of detail created the need for a larger space – a request that was answered by the expansion of the building, especially in 1909. Prior to the introduction of scientific management ideas, the broadly categorized departments in the office were small and required little space in which to operate. The new ideas in management created the need for a larger space and the effective reorganization of the interior on a fairly regular basis.

The Calumet and Hecla Office Today

Although Calumet and Hecla experienced an uptick in business during World War II, the post-war years were not as successful. After 1945, profits declined, relations with workers became tense, and a strike in August 1968 put C&H in a position in which they could no longer function. In 1968, Universal Oil Products (UOP) purchased the company[36]. During this time, the office building remained unchanged, though UOP operated the Calumet division out of the old library building. In 1975, two local doctors purchased the general office building and within a few years converted it to a medical

[36] Brian Hoduski. Interview by Renée Blackburn, March 7, 2011.

facility. Some of the changes involved in this modification included the installation of an elevator, movement of stairways, and adjoining of some rooms. The medical facility operated from 1979 through 1993, though after 1993, the doctors allowed the KNHP to utilize some rooms on the second floor for office space.

After the medical facility closed, KNHP moved into the entire building and, in 2000, purchased the building for use as the KNHP headquarters (Keweenaw 2001; Figure 3.10, Figure 3.11, Figure 3.12, Figure 3.13, Figure 3.14, Figure 3.15). The library building is also part of the KNHP and contains the museum division for the park. The interior of the office building had been extensively modified. However, some original elements can still be seen. On the first floor, some of the original wood flooring is present in the welcome area, which upon first construction was the location of the Superintendent's office. Additionally, there are remnants of the original ceilings in the offices in the east addition on the first floor. Unfortunately, much of the second floor was beyond salvage, though the floor plan has been restored close to original construction[37]. Overall, KNHP has worked to restore the building as close to original construction as possible.

[37] Brian Hoduski. Interview by Renée Blackburn, Mar 7 2011.

Figure 3.10: KNHP Headquarters, formerly the C&H mine office. Photograph by author, 2011.

Figure 3.11: Front entrance to KNHP headquarters on the east side of the building. Photograph by author, 2011.

Figure 3.12: View of KNHP headquarters looking southwest. The north addition with payshed and east addition are present. Photograph by author, 2011.

Figure 3.13: View of KNHP headquarters looking south. In the foreground is the north addition payshed, with the east addition also present. Photograph by author, 2011.

Figure 3.14: View of KNHP looking northwest. The 1909 east addition is in the foreground, including a view of the door added to the east end. Photograph by author, 2011.

Figure 3.15: Close-up of KNHP headquarters. This is the original south side, along with the 1909 east addition in the rear. Photograph by author, 2011.

CHAPTER FOUR

CASE STUDY: QUINCY MINING COMPANY

Organized in 1846, the Quincy Mining Company (QMC) spent its early years attempting to gain momentum in the copper mining industry. Corporate headquarters were located in New York, while the mine overlooked Hancock, Michigan (Figure 4.1). After years of searching, QMC finally discovered a lode that would bring them into the forefront of copper mining companies in Michigan. Using knowledge gained from the opening of the Pewabic lode on neighboring property, QMC discovered that this lode extended onto their property and began working it as well (Lankton 1991). By the end of the nineteenth century, Quincy's status as a major influence in the mining community had gained recognition beyond the Copper Country and the east coast. As their future solidified, the need for a larger, more grand mine office became necessary and, in 1897, the new Quincy mine office was completed (Figure 4.2).

The 1864 Quincy Mining Company Office

One of the first office buildings of the Quincy Mining Company was located to the south of the current building in a two-story wood framed construction structure (Figure 4.3, Figure 4.4). Originally built in 1864 – 1865, according to photographs, the old office appears to be a side gabled two-and-one half story structure that resembles a residential dwelling. A previous office existed at the mine site for the company, originally constructed in the 1850s. A 20 December 1864 journal entry for Emery Lord

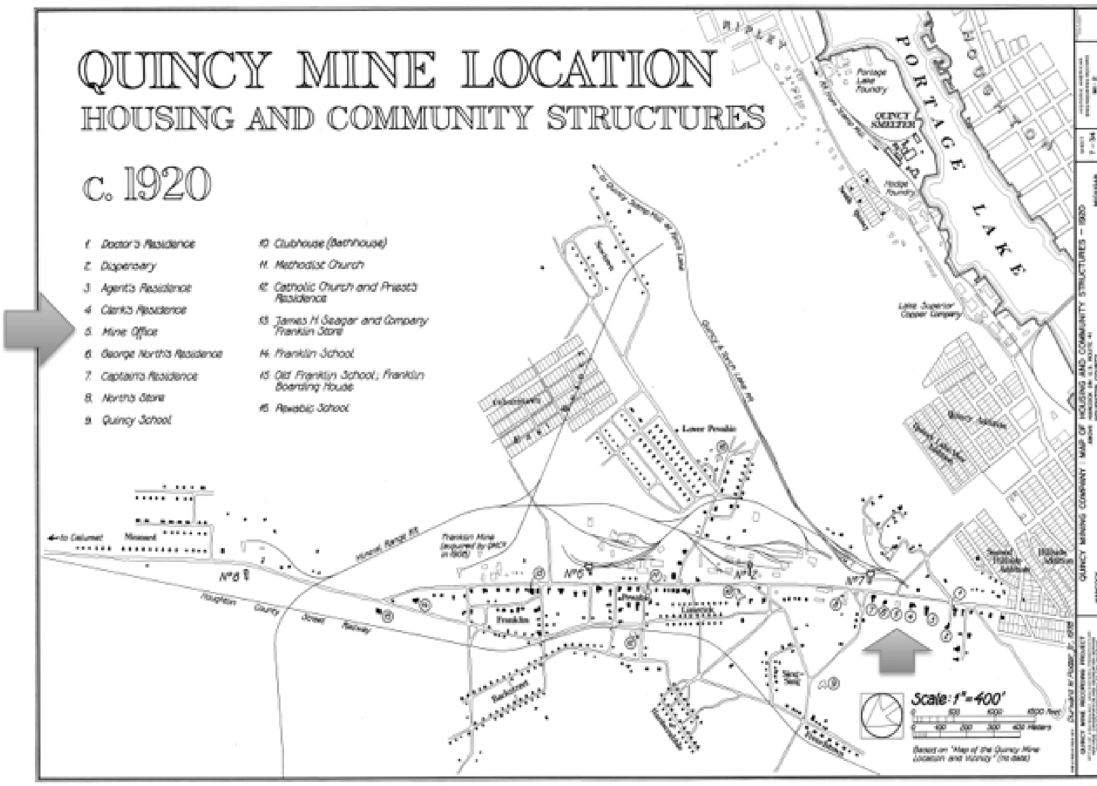

Figure 4.1 – The Quincy Mining Company landscape in 1920, #5 indicates the location of the office on the landscape. Image courtesy of the Library of Congress, HAER Documentation, Quincy Mining Company.

Figure 4.2: View of Quincy Hill from Houghton, Michigan, ca. 1910. Arrow points to location of 1897 QMC office on landscape. Image courtesy of 1910 QMC Annual Report, MTUA/CCHC Collection MS-001.

Figure 4.3: Construction of the 1897 QMC office with 1864 office in background, looking south from road. Image courtesy of MTUA/CCHC, image #:MS015.MI.2.218.

Figure 4.4: Detail of front façade of 1864 and 1897 QMC mine offices, looking north. Notice the stark contrast between the materials and construction of the old versus the new office. Image courtesy of MTUA/CCHC, image #:MS015.MI.2.217.

& Company includes a payment of $1,125 for the construction of a new mine office, with an additional $45.00 for extra labor (Quincy Mining Company 1865:486). There were two doors flanking either side of the front, with simple steps leading to the southern front door. Though it appears that the ground was not graded upon construction of this office, as the northern end sits on the ground while the southern end is raised off the ground, the photograph shows that the building was moved south on the site in order to accommodate the new office. There was originally a cellar as the company paid $79.60 for "46 days of digging sellars [sic]" on 19 September 1864 (Quincy Mining Company 1895:446). The old office projected an air of low capitalization that dominated the early years of the Quincy Mining Company.

The 1897 Quincy Mining Company Office

The 1897 Quincy Mining Company office, in contrast, was an imposing feature on the landscape, indicative of the company's success at the time. In a way, the office acted as a display of the company's permanency in the Copper Country. Built of local, red sandstone and designed by architect Robert C. Walsh of Morristown, New Jersey, upon completion, Superintendent Harris wrote to the stockholders that, "the new office is a substantial two story building 45 x 56 feet of Portage Entry red sandstone. It is pleasantly situated, and makes a very convenient and serviceable office" (1896 QMC).

The architects and company officers were located in New Jersey and New York, respectively. Because of this, much of the decision-making regarding the office plans was done through correspondence between President Thomas F. Mason and Superintendent (then titled Agent) Samuel B. Harris, who was at the mine location in

Michigan. Through various correspondences between the two, both men were able to share their expertise on what they thought would be best for the new office. Mason's ideas for the office appeared to be more superficial in nature, mostly based on his aesthetic ideas about which he wrote to Harris. On the other hand, Harris was more concerned with the practical layout of the building and its overall construction. Though both men were concerned with different aspects of the design, it is not to say that either was oblivious to other factors. Merely, each had his ideas of what was most important.

Correspondence between Mason and Harris, regarding the plans for the new office, date back to at least 1895. The officers of the company, particularly Mason, held a keen interest in the beauty of the building and its immediate surrounding landscape. While discussing the plans with Harris, Mason wrote to him on July 12, 1895 making various suggestions for the layout of the front[38]. In order to make it more appealing to the passerby, Mason hoped there would be ample space in the back, and thus out of sight, for horses to be tied and he wished for a graded front yard, in order to raise the office above the street level. Some of Mason's requests came to fruition, though his wish for a small entrance did not happen. The finalized porch contained five steps, though the front was set off from the road and the property enclosed by a short fence, which rounded at the entryway to the office's walkway. Also, horse hitching posts were located on the road in front of the office, which again, went against Mason's wishes (Figure 4.5).

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[38] Hope you will get up a nice building, that will be ornamental with enough ground in front to set it off nicely and a place in rear to drive into so that fellows won't hitch their horses at the front door. I like an entrance without more than two steps to ascend. This can readily be done by grading up from the street which I think will have a better appearance.

Figure 4.5: QMC office building. Note horse hitching posts and grand entryway, both of which Mason opposed. Photograph most likely taken around beginning of twentieth century. Courtesy of MTUA/CCHC, image #:MTU Neg 03759.

Mason also made his own suggestions regarding the interior. In one letter from July 12, 1895, Mason wrote to Harris that, "it may be a convenience to you to have a window at your office like clerks for men to come, that wanted to see you." Though Mason makes this suggestion, the idea did not come to fruition (Figure 4.6) and, unlike the other rooms on the first floor of the office, the Agent's office had only one access point, through a door that accessed the front hall. Harris' interior suggestions were just as influential as his exterior suggestions. More familiar with the mine site and its needs than the company officers in New York, both Harris and even the views of the other office workers were very influential to the planning process. His ideas were practical while still aesthetically pleasing.

Figure 4.6: QMC Office, looking southwest. Mine Agent/Superintendent's office located in northeast corner. Date unknown, though this photograph was most likely taken in the 1910s as the fence no longer has an opening for the sidewalk that leads to the rear of the building. Image courtesy of MTUA/CCHC, image #:Acc.03.095D.001.008.

The men were in no rush to construct the building, rather they wished to take their time and prepare the materials and finalize drawings ahead of time. These drawings went through multiple revisions, each time being sent out to Harris at the mine on which to make suggestions regarding the best layout for the interior and exterior of the structure. While the architects were still in the initial stages of drawing the office plans, President Mason and Superintendent Harris were already deep into the prospects of the best location and removing unsightly buildings from the view shed of the new office.

Although Mason was president of the company, Harris' input was valuable to the entire process and many of his recommendations were adopted into the office plans (Figure 4.7, Figure 4.8). In an August 7, 1895 letter, Mason requested that Harris write back to him regarding details for the new office exterior, specifically how high the first floor should be from the ground level. Writing to Treasurer William R. Todd on August 19, 1895, Harris provided some more improvements to the plan that made it easier for those within it to work, as well as for the men coming to the office for their pay[39].

Figure 4.7: Original front elevation drawing for QMC office by architect Robert C. Walsh. The major difference between the drawing and actual construction was the change in shape of the dormer window. Photograph courtesy of Library of Congress, HAER Documentation, Quincy Mining Company.

39 I – we all – have examined the plans carefully and consider the whole design to be very fine indeed. I might make certain trifling suggestions, but they might not be improvements, after all. As you intimated the door between clerks' rooms should certainly be placed near to vault. As to men's entrance to pay windows, it occurs to me it might be better to place the outer window on the other side, where the door now is in your plan, and place a double door where the window now is. This, with a securable railing, would enable them to approach and retire from the pay windows without crowding each other at all… I think the vault may as well be carried up full size because the cost will be about the same if it is made smaller, and then are a great many thousand dollars worth of maps, etc. to be taken care of there. In one of the upstairs rooms: say the one over the assistant clerks – these should be a lavatory – for that room will probably be the 'blue print' room and they will need water there.

Figure 4.8: Original north side elevation of QMC office by architect Robert C. Walsh. Photograph courtesy of Library of Congress, HAER Documentation, Quincy Mining Company.

Additionally, Mason wrote to Harris on September 9, 1895, agreeing to Harris' suggestion that the architect, "use the red or terra-cotta stone for front and sides rough with perhaps, the ordinary for the rear – slate roof – hard wood floors for halls and also clerks rooms."

Upon moving from old office to new, Superintendent Harris stated in a December 31, 1896 letter to President Mason, "we moved into our new office Wednesday morning last and feel greatly rejoined thereof – for the old dungeon was killing the whole of us." The new office was not yet completed when they made this move either, as Harris continued to state, "Our new quarters are very fine, but we need a little new furniture to brighten it up – and to be in respectable keeping with the building. The upstairs rooms are not painted yet – but soon will be." On January 7, 1897, the Portage Lake Mining Gazette reported that, indeed, the first floor was complete and that it was one of the finest office buildings in the Upper Peninsula[40].

Additional correspondence between Harris and Mason regarding the construction of the new office eluded to the old in terms of what would need to happen in order for the new office to represent the company in an appealing light. In a March 4, 1897 letter from Harris to then-Treasurer Todd, Harris stated that "the old mine office building is now removed out of the way, which adds very materially to the appearance of the new office and surroundings."

According the original blueprints, the majority of the rooms in the office were built for specific functions (Figure 4.9). However, those on the second floor were not given any function, but perhaps served as extra space in which the company could expand its mine office work (Figure 4.10). In addition to the general manager's office – on the drawing, the agent's office – the first floor also contained an office for the chief clerk, in which the safe was located, which connected to the front hall and to the assistant

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[40] "The Quincy Mine office, work on which was commenced last spring is now competed so far as the first floor is concerned and only the finishing remains to be done in the second story. The building is of Portage Entry sandstone. The doorway opens into a wide hall on the north side of which is the private office of Supt. S.B. Harris and on the south side that of the clerk, E.D. Johnson, in the rear of M. Johnson's office is the general office occupied by Assistant Clerk McLeod and assistant. On the north side is a good sized room to be occupied by the township library, the stairs to the story above also lead from this side. On the second story is the private office of Engineer J.C. Harris, a large draughting room and two spare rooms, one of which will be used as a photographic room. The building is finished entirely in oak with oak floors. In each of the important rooms there is an open fire place. It is heated by both direct and indirect radiation and lighted with electricity. A fireproof vault starts in the basement and extends through each of the two stories. Take it all together and it is one of the most complete office buildings in the Upper Peninsula" (Portage Lake Mining Gazette, Jan. 7, 1897, p. 1, MTUA/CCHC).

clerk's room, where the pay window was located (Figure 4.11). Attached to this was a general office that served as a waiting room for workers while waiting to receive their pay, which was attached to the rear porch. The rear porch was the entrance for mine workers, as only those who worked in the office entered through the front door. And finally, in the north, rear corner, was a library, which had an opening from the waiting room and from the hallway within the front of the office. This library served the township and Quincy staffed a librarian. Beyond the mention of blue printing operations, the second floor contained five main rooms, with a lavatory in the rear over what would be the first floor waiting room. The rooms were all located above their first floor counterparts; however, the fifth room existed where the vestibule and front hall exist on the first floor. The front, south room on the second floor was only accessible through its two flanking rooms.

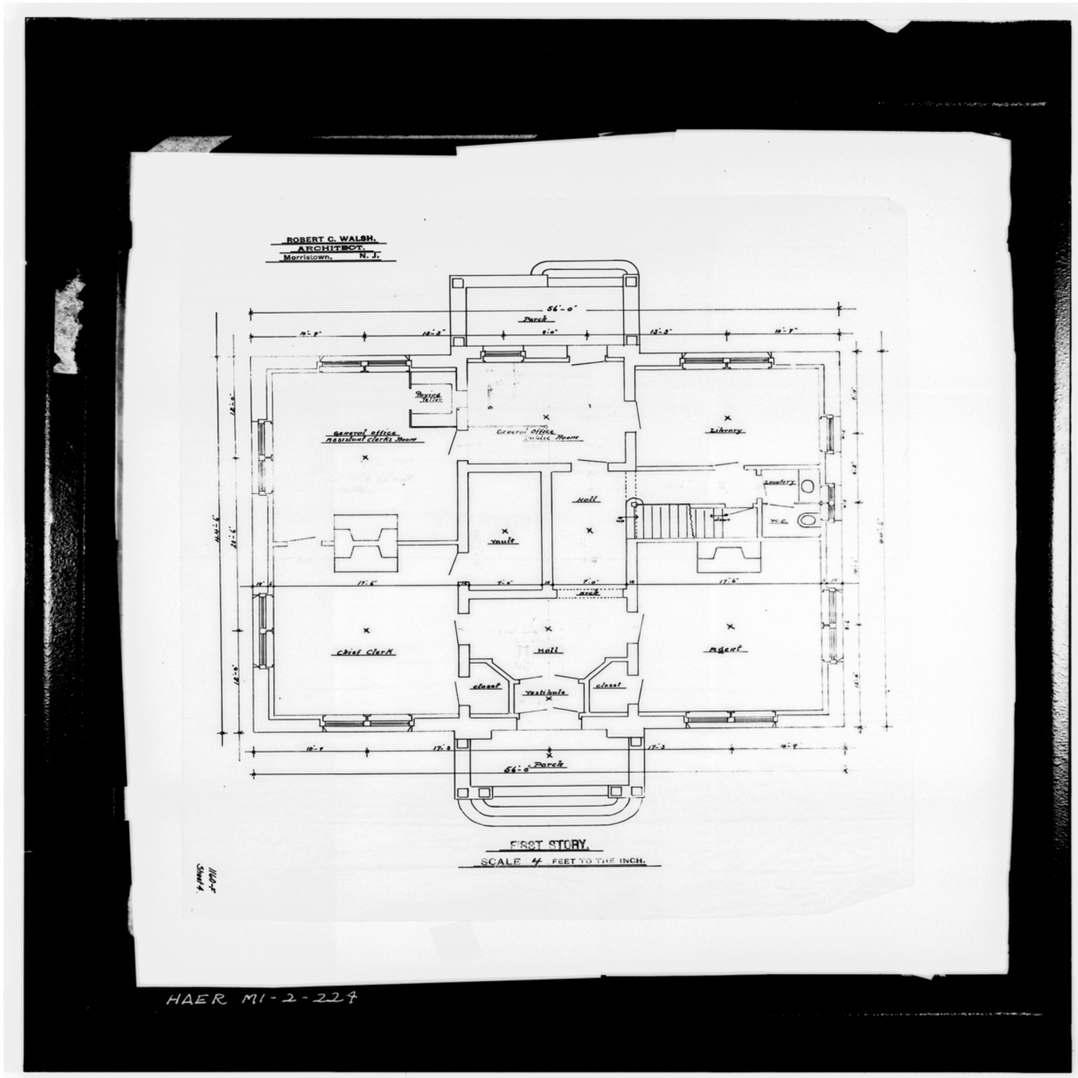

Figure 4.9: Original first story floor plan of QMC office with labeled rooms and dimensions. Photograph courtesy of Library of Congress, HAER Documentation, Quincy Mining Company.

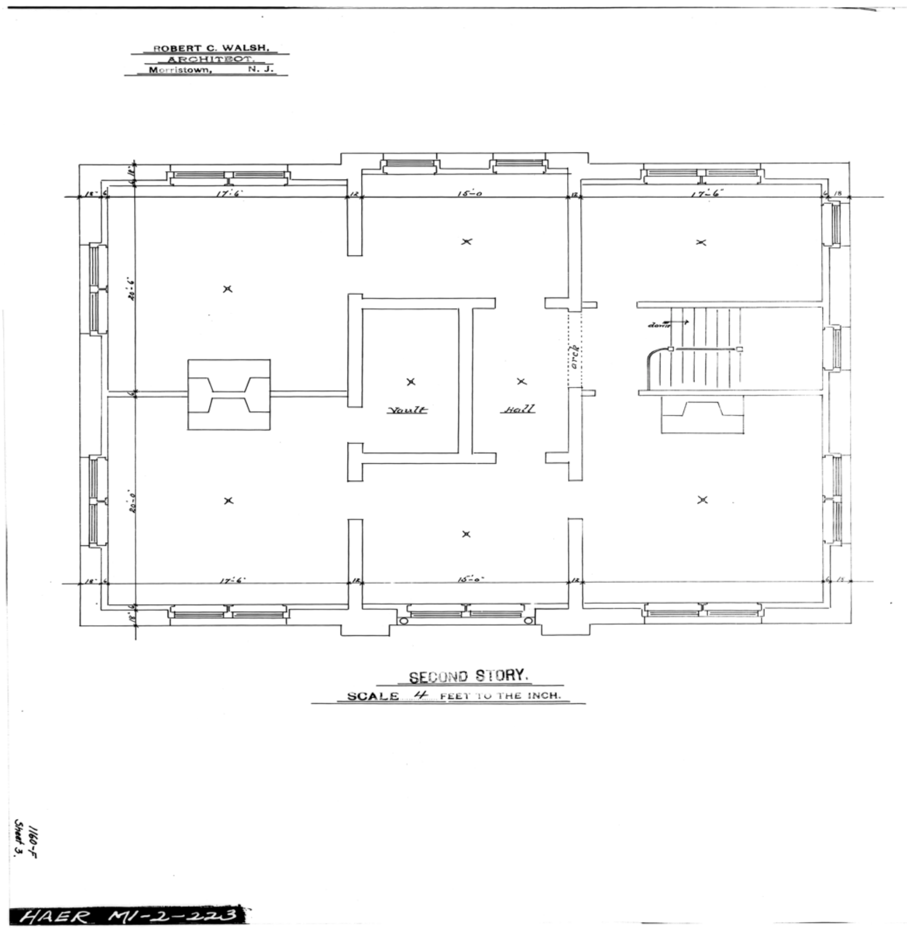

Figure 4.10: Original second story floor plan of QMC office without labeled rooms. Photograph courtesy of Library of Congress, HAER Documentation, Quincy Mining Company.

Figure 4.11: Man on horse outside gate leading to rear entry of the Quincy Mining Company office. Large arched window on side of building marks the location of the general manager's office. Photograph most likely taken around turn of twentieth century as man on horse is positioned in front of the gate that leads to the rear of the building where the pay windows were located. Image courtesy of MTUA/CCHC, image #:Acc.541.01.01.1991.001.016.

QMC Management: The Lawton Years, 1905 – 1946

During the planning and construction years of the office, the relationship between management at the mine and the officers in New York was very cordial, both respecting the other's views and incorporating them as each saw fit, all without, seemingly, offending the other party. Within a few years of the office construction, many changes in main mine management and officers occurred (Table 4.1). During the first five years of the twentieth century, a rapid succession of changes occurred at all levels of top company management, including the President, Vice-President, Treasurer, Secretary, Mine Clerk and Mine Superintendent. These changes cumulated into the appointment of Charles

Table 4.1: QMC Corporate and Mine Management. Table shows changes in management from late nineteenth century through end of Charles Lawton's time as general manager. Pre-Lawton management shown to indicate rapid succession of change right before Lawton became general manager. * indicates a break in existence of that particular position. Data from QMC Annual Reports and Lankton and Hyde 1982.

Position	Person	Years
President	Thomas Fales Mason	1858 - 1872, 1875 - 1899
President	Thomas Henry Mason	1899 - 1902
President	William Rogers Todd	1902 - 1924
President	W. Parsons Todd	1924 - 1976
Vice-President	Thomas Henry Mason	1892 - 1899
Vice-President	Charles Devereaux	1899 - 1904
Vice-President	Walter P. Bliss	1904 - 1912
Vice-President	W. Parsons Todd	1912 - 1924
Vice-President*	William M. Belcher	1924 - 1933
Vice-President*	John P. Moulton	1942 - 1945
Treasurer	William Rogers Todd	1873 - 1902
Treasurer	William A.O. Paul	1902 - 1937
Treasurer	Austin M. Mansfield	1937 - 1954
Secretary	William Rogers Todd	1869 - 1902
Secretary	William A.O. Paul	1902 - 1937
Secretary	Austin M. Mansfield	1937 - 1957
Mine Agent/Superintendent	Samuel B. Harris	1884 - 1902
Mine Agent/Superintendent	John Luther Harris	1902 - 1905
Mine Agent/Superintendent	Charles L. Lawton	1905 - 1946
Mine Clerk	Edward Johnson	1892 - 1899
Mine Clerk	Armitage Benedict	1899 - 1900
Mine Clerk	Angus F. MacDonald	1900 - 1901
Mine Clerk	Henry C. Fish	1901 - 1904
Mine Clerk	Frederick J. McLain	1905 - 1931
Mine Clerk	Ross Dunbar Blackburn	1931- 1945

Lawton as mine superintendent in 1905, a position he would hold until 1946, and a corporate and mine management force that would change little during his roughly forty year term. This five-year period before Lawton's entry as Quincy's general manager also encompassed one of the largest growth periods for Quincy. From 1890 through 1905, Quincy sank multiple shafts and opened many new surface plants. All of this growth aided Lawton in his initial years as Quincy general manager (Lankton 2010).

Charles L. Lawton was Quincy's manager for more than forty years, the longest of any previous manager, and saw the company through the rough years of the early twentieth century. Lawton graduated from the Michigan Agricultural College, now Michigan State University, with a mechanical engineering degree, and then completed a course at Michigan College of Mines, in Houghton. After this, Lawton spent sixteen years working for many companies around the United States, including some in Michigan's Iron Range. Before returning to Michigan, Lawton worked at the Dalton & Lark mine of the Bingham Consolidated Company in Salt Lake City, Utah. In 1904, Lawton came to Quincy and stepped in as assistant superintendent to John L. Harris, son of previous superintendent Samuel B. Harris. By 1905, President Todd had appointed Lawton the new superintendent at the Quincy Mining Company (Quincy Mining Company 1906).

During these transition years in management personnel, new ideas began to change the structure of the organization and the relationships of those within its top ranks. In much of the correspondence between Todd and Lawton, there is present a hierarchy that was not seen in the correspondence between Mason and S.B. Harris. Lawton often asks Todd whether to go ahead with various projects, supply orders, and other issues at the mine – unless they are of a very time-sensitive nature. In those cases, Lawton often writes to Todd explaining the issue and Lawton's solution, then ending the statement by stating that Lawton's decision can be overturned if it is not to Todd's liking.[41]

Lawton managed Quincy during its most profitable years while also riding it down through its worst years. Quincy was very successful in the first two decades of the twentieth century. Between 1905 and 1918, Quincy paid out $11,980,000 in dividends and had record numbers of production. In the two years between 1909 and 1911, Quincy produced over 22,000,000 pounds of copper annually (Pyne 1957: 233).

The introduction of efficiency engineers to help the mine adapt new, cost-effective technologies spurred changes in operations across the mining landscape; however, many of these changes were also influenced by the introduction of similar techniques from other companies, like C&H. Quincy began to establish specific departments for different mine matters, including the Department of Safety Inspection and the Employment Department in the early 1910s. Though the future prosperity of the mine was of utmost importance to both Lawton and W.R. Todd, their means of obtaining profitable returns were different. Lawton's opinions were often to the benefit of the company, but also attempted to help elevate his own workforce. President W.R. Todd wished only for profits, potentially at the expense of workforce relations[42]. President

[41] The drawings and patterns have got to be made, etc., which will take considerable time. If, upon your arrival here, it is decided that we will not put the head in, we can cancel the order, and the expense will only be for the drawings and possibly something towards pattern making. March 27, 1906

[42] On June 24, 1912, W.R. Todd wrote to Lawton, "I am sorry to have you again bring up that hobby of yours which I dislike very much in regard to personal friendship, which has nothing to do with the official business of the Quincy Mining Company or its officers. Such things have no weight or influence with me" (MTUA/CCHC, Collection MS-001, Box 343, Folder 014).

W.R. Todd pushed Lawton to hire an assistant from outside the current Quincy engineers – one who was a mining engineer with extensive knowledge of underground and surface workings, so as to improve upon the efficiency of the operations[43].

Many years of frugal management allowed Quincy to keep dividends high and keep the mine operating, even through the rough years of the strike in 1913 and 1914. Although Lawton kept Quincy profitable, he was not always favored in the eyes of the corporate management and board of directors. In 1915, in the aftermath of the strike, the board of directors resolved to fire Lawton, a request on which President W.R. Todd did not follow through[44]. In 1919, Quincy's corporate management was essentially the same as in the 1860s, as the top management positions on the east coast were passed down from father to son[45] (Pyne 1957).

After the end of World War I, Quincy's success began to slip as copper prices declined and the costs of operating grew. Lawton had to downsize his office staff to keep the company profitable. In the mid-1910s, the Quincy mine office was bustling with workers ranging from accountants, engineers, draftsmen, clerks and typists, to name a few (Figure 4.12). During the final years of the First World War, a number of women

[43] On December 30, 1912, W.R. Todd wrote to Lawton, "… you shall select from Houghton or Marquette County a suitable Mining Engineer, aged between thirty-five and forty-five years, with knowledge of mining and experience underground, to be appointed, with my approval, after I have had an opportunity to see and talk with him, Mine Safety Inspector and Efficiency Engineer underground. Mr. DeSollar, for reasons given, cannot fill the place. This business has been considered by our Board, and the Directors at last meeting adopted a resolution authorizing me to make this appointment and fix the salary… We have had some people in view for the position of Mine Safety Inspector and Efficiency Engineer, but will not proceed in this until hearing from you that you have failed to obtain a person you can recommend" (MTUA/CCHC, Collection MS-001, Box 343, Folder 016).

[44] At the March 2, 1915 annual meeting, the board of directors resolved, "that the president be and he hereby is directed to terminate the employment of Mr. Charles L. Lawton, as soon as in his judgment it can be done with due regard to the best interests of the mine" (MTUA/CCHC, Quincy and Michigan Copper Mining Research, Acc. # 03.008A, Box 3, Folder 35).

[45] See Table 4.1, T.F. Mason passed it down to his son, T.H. Mason. Then W.R. Todd, who had been Secretary and Treasurer since 1869, became president only to pass it to his son, W.P. Todd. The Mason-Todd presidential reign lasted over 100 years.

worked in the office as stenographers, typists and clerks[46]. As the price of copper dropped, and Quincy had to lay off some of it's workforce, these women were the majority of the office casualties[47].

Figure 4.12: Male and female employees working on the second floor of the Quincy office, ca. 1917. The woman appears to be at a typewriter while the men are working at adding machines. Man in center is working at a Burroughs adding machine. There is a large drafting table to the left, along with a stamp punch on the cabinet in the forefront of the photo. All of the objects mentioned are now located in the QMC office collection at KNHP. Image courtesy of MTUA/CCHC, image #: MS001.350.010.03.

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[46] Quincy had a female librarian, Ethel Fischer, who had been there before Lawton became general manager (MTUA/CCHC, Collection MS-001, Box 146, Folder 001).

[47] In analyzing the employment records of office workers from 1918 through the mid-1920s, there were 22 female clerks, stenographers, typists, and telephone operators. Some of these women were the daughters of Quincy mining captains. For example, Ruth Kendall, whose father was Captain Kendall, and Margaret Francis, whose father was Capt. George Francis, worked as clerks in the mine office. According to their employee cards, the majority of these women either left to be married or were let go due to "reducing workforce," though some also left for other positions in other locations outside of the Copper Country. The male office employees, who had titles like efficiency engineer, clerk, and time keeping, were not let go as often as their female coworkers. Though some of the males were let go due to "reducing workforce," many either stayed or left for a "better job" (MTUA/CCHC, Collection MS-001, Box 314, Folder 002).

In the late 1910s, as copper prices reached a low of 12.5 cents, Quincy invested in an impressive new hoisting engine that allowed them to operate at depths almost 14,000 feet below the surface[48]. After installation, Quincy was mining around 9,000 feet on the incline (Pyne 1957). The new No. 2 Nordberg hoist reduced costs for the company. Lankton wrote that the new hoist did this in two different ways, "first, it was a compound engine that used steam twice," and "then, when that steam was exhausted at a lesser pressure, instead entering the atmosphere it was piped across to the second side of the hoist, where it drove the larger pistons" (2010:220). Though they had this impressive new hoisting technology, economic hardships and problems underground meant the company still had to reduce their mine and surface workforce.

Even with a workforce reduction and new hoisting technology, Lawton struggled to keep the mine profitable. This struggle extended beyond profits as he worked to make the east coast management happy while also working within the realities of the mine location. In 1926, Lawton wrote to Vice President William Belcher regarding new prospects on the property. New discoveries at the bottom of shafts no. 2 and no. 6, according to Lawton, may have been the answer to Quincy's production problems[49]. As

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[48] William Pyne (1957: 238) quoted the 1924 Keweenawan's description of the new hoisting equipment, the largest in the Copper Country, "The hoist operates in balance and is designed to raise a load of 20,000 pounds of rock from a depth of 13,350 feet at a speed of forty miles per hour. The drum is of the cylindroconical type, with a maximum diameter of thirty feet, and weighs 516,000 pounds, exclusive of the shaft. A cross-compound steam engine, with two high-pressure and two low pressure cylinders, one of each on a side, is attached to cranks of the drum. Each engine is set at forty-five degrees to the vertical. Eight impulses per revolution, together with the great mass of the hoist, eliminate all pulsations in the rope. The condensing equipment is designed to handle 1,460 pounds of steam per trip of 10,000 feet. The total weight of the hoist with condensing equipment is 1,765,000 pounds; the floor space covered is 60 by 54 feet; and the vertical heights of 13,300 feet of one and five eighths inch rope is 55,200 pounds, and the weight of the skip is 10,000 pounds" ("The Quincy and Pewabic Mines" *The Nineteen Twenty Four Keweenawan,* Houghton, MI: Michigan College of Mines, 1924. p. 254).

[49] On February 22, 1926, Lawton wrote to VP William Belcher, "Now, I realize that I am inclined to be overly enthusiastic or optimistic. You and Mr. Todd will have to be the conservative ones… This new

the year progressed, Lawton remained optimistic in his correspondence with VP Belcher, though when the new discovery began to dissipate, this relationship became more strained as the corporate management wished for faster results[50]. However hopeful Quincy was about this new prospect, copper prices did not improve as they had anticipated, causing difficulty in operating at profit, especially with the costs associated with the new hoist and other improvements on the landscape.

The difficulties of the 1920s remained into the 1930s as the nation fell deeper into the Great Depression. Toward the end of the 1920s, as copper prices dropped and the cost of mining rose, Quincy was put in a difficult position. Early in 1931, Lawton began to realize that the mine could not operate profitably without a change in the workforce. He attempted to avoid laying off workers, instead attempting to assuage the situation by cutting wages. This was a move he tried to avoid, but could not[51]. Lawton discussed this matter often with the other office staff, and their general feeling was "whatever you do, don't shut down.[52]"

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mineralization may pull us out of the hole, and it may do it very handsomely, but we must be conservative for a time yet" (MTUA/CCHC, Collection MS-001, Box 345, Folder 001).

[50] Lawton wrote to Belcher on October 4, 1926, "I know that you realize I am very much concerned over the, in a way, unsatisfactory results of our operations. Naturally I believe it worries me a great deal more than anyone else. We must get all of the efficiency installations now provided for, installed, and in good operating condition, before we can expect to get the results that we have figured out, but I tell you, they come slow, although we are pushing the work on those installations just as fast as we know how" (MTUA/CCHC, Collection MS-001, Box 345, Folder 001).

[51] On May 13, 1931, Lawton wrote to President Todd, "At this time there are a quite a number of men laying off. Some going back to their farms, others are not imbued with the idea of the seriousness of the general situation. It has been hard to make some of the Bolshevik fellows understand. However, they are relatively few in number, whereas, the rank in file [sic] seem to understand what is going on…
In this connection, I have been seriously considering another 10% cut in wages. I wish it could be avoided, but I really think it would be best for the men and their families to work for a lesser compensation than to have the mine shut down entirely; therefore we have been quietly promulgating the question of shutting down, or a further wage reduction" (MTUA/CCHC, Collection MS-001, Box 360, Folder 083).

[52] MTUA/CCHC, Collection MS-001, Box 360, Folder 083. Letter from Lawton to President Todd, May 13, 1931.

While attempting to operate at the same levels as in previous years, it quickly became apparent that this was not financially feasible. On June 17, 1931, Quincy shut down operations for a three-week period, starting again July 8, 1931. During this time, the company did not charge rent on company housing and when work resumed, operations were as they had been before the temporary shut down (*News of the Industry* 1931a: 37). The only exception to this was the Mesnard shaft, at which some workers did not appear for work[53]. This would not be the last of Quincy's hardships as Lawton had to balance the actual mine realities with the assumed mine realities of the east coast office.

Though operations resumed in July, operations were still difficult during that summer. Just two days after reopening on July 8, Lawton wrote to Belcher that although everything was operating smoothly, little production was happening[54]. Lawton struggled to ramp up production to pre-shut down levels while also meeting the demands placed upon him by President Todd. Todd wished for Quincy to get costs below 10 cents, which would require cutting men, but Lawton found this task difficult[55]. For the rest of July, operations at the mine and surface plants struggled to regain pre-shut down levels, while operating at a profit with less workers.

[53] Lawton wrote to Belcher on July 8, 1931, showing a rare toughness not usually seen in his actions, "Everything seems to have started off smoothly this morning with every man in his place in #2 shaft, four absent in #6 and 8 out at #8. The Mesnard shaft is the more careless shaft of the three. We shall discipline these men by laying them off, so also those absent on the night shift" (MTUA/CCHC, Collection MS-001, Box 345, Folder 012).

[54] Lawton wrote to Belcher on July 10, 1931, "Everything about the mine seems to be running along quietly and smoothly, except that the production does not come out. It seems to be difficult to get back to the old swing, although the production is fairly up with 274 skips of copper rock yesterday… It is about the first time I have felt a little discouraged, especially so when I note the market for copper, and what we have to accomplish. However, everybody is doing their utmost" (MTUA/CCHC, Collection MS-001, Box 345, Folder 012).

[55] Regarding production levels, Lawton wrote to Belcher on July 14, 1931, "It is going to be very difficult in operating anything at all like normal mining with a restricted force underground, and shorter days, to get the costs down as Mr. Todd says, below 10c., but we will see how we come out for this month. It is likely to be our best under the conditions prevailing. Low costs cannot be made under restricted operating conditions" (MTUA/CCHC, Collection MS-001, Box 345, Folder 012).

Quincy again shut down in August. This time, it was planned for five weeks and operations would resume in September, with the men moving to a six-day workweek. Again, the company did not charge workers their rent during the shut down. Part of the difficulty in the shut down was due to recent improvements in the surface plants at the No. 2 and No. 6 shafts, including the new hoist at No. 2. Additionally, they had recently improved the surface plant at the stamp mill on Torch Lake. Overall the costs associated with recent improvements soared well above $102,000, while Quincy's current mine output was only around 1,000,00 pounds of copper per month (*News of the Industry* 1931b: 135).

Once operations resumed in September, it again quickly became apparent that the mine could not operate at a profit. On September 22, 1931, Charles Lawton had the unfortunate task of informing employees that the mine would be closed indefinitely. There was, however, full intention of reopening the mine and during the shut down there was an attempt to keep the mine intact for immediate resumption of operations (*News of the Industry* 1931c: 274). Though the company was operating at a loss, the attempt to remain open was much appreciated by the workforce, who thought that management was doing the best they could under trying circumstances (*News of the Industry* 1931c: 274).

Though shut down, operations in the mine office continued. Lawton now had the task of managing the properties to keep them in order for the mine's eventual reopening while also juggling the realities of life at a mine site for the workforce. As the company rented out much worker housing, concessions in terms of rent and other amenities were offered to employees for as long as Quincy could do so[56]. By 1937, Quincy was ready to reopen, though this would not come easily. In January, Quincy got off to a rocky start, but by March, their output was continuously increasing (Pyne 1957). Though they would never reach production levels like those of the early 20th century, Quincy was able to reopen and operate on a smaller capacity.

During the first half of the 1940s, Quincy was able to ramp up production for World War II, but the new demands of the union spelled disaster for Quincy. In early 1941, the realization that the company could not offer wage increases led to a strike. Additionally, the Metals Reserve Company contracted to purchase all of Quincy's copper, which helped Quincy survive, but barely. As the company and workers agreed to a truce and copper prices were still low, by 1945, the mine could no longer operate profitably, causing the mine, once again, to close as their contract with the Metals Reserve Company expired in August (Lankton 2010).

Material Culture of the Quincy Mining Company Mine Office

The ways in which the company acquired, tested, used, and modified new technologies to fit their needs is evident in the relationship between the purchasing clerk, the companies providing objects, other mine's systems, and the view and opinions of Lawton and the corporate management. Changes, like a new check system, were often conceived in the mine office but were sent to the corporate office for approval. In

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[56] On September 24, 1931, Belcher wrote to Lawton, "I certainly am fully in sympathy with giving the employees the privilege of chopping and gathering wood for their winter's fuel. Am also in favor of giving them their rentals of the dwelling houses during the close down. It is no more than we should do. I think we should do all for those men that is possible for us to do, with our means. The close down is hard not only for the Company, but its officers and employees, and no one can see far enough ahead to describe what the future has for us" (MTUA/CCHC, Collection MS-001, Box 345, Folder 013).

February 1907, purchasing clerk McLain wrote to President Todd that soon he needed to place a new order for checks, but wished to change the system to make it more efficient and cost-effective for the company[57]. His opinion was based not only on his experiences with the current system but also based on what other firms were doing in terms of check handling. He looked for the approval of the president before continuing. In 1908, McLain purchased an Addressograph machine to simplify the payroll process even more[58].

The introduction of new technologies was also, at times, brought about by the frustration of old technologies. The blueprinting process Quincy used prior to 1910 consisted of placing the prints in the sun for exposure. Due mostly in part to the geographic realities of their location, this process often caused delays in printmaking or complete failure of the print and the need to start again. In November 1910, Quincy's head engineer, Tenney DeSollar, wrote angrily to Lawton about the blueprinting process and provided Lawton with suggestions for new technologies[59]. DeSollar's main

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[57] McLain wrote to Todd in February 1908, "I shall soon have to order a new supply of checks and drafts, and I have for some time had in mind changing the form which I have been using, so as to do away with the separate receipt.
The practice of requiring the payees to sign and return a receipt for the draft received is being discontinued by the majority of up-to-date firms. It involves an expense to us of furnishing return envelopes, and an expense to the payee of a two-cent stamp in each case – to say nothing of the break in records caused by failures to sign and return the receipt, and if it shows the items which it covers, it constitutes a sufficient receipt.
I enclose you herewith a form I have prepared, which is a combination of several forms I have seen, and which I shall adopt, if it meets with your approval… I trust you will have no objection, as I have felt for some time that our present method of requiring a receipt returned is considerably behind the times" (MTUA/CCHC, Collection MS-001, Box 350, Folder 003).

[58] MTUA/CCHC, Collection MS-001, Box 350, Folder 020.

[59] In apparent frustration and annoyance with the current process, on November 10, 1910, DeSollar wrote to Lawton, providing him with a brochure with the blueprint machine he wanted noted, about the lack of efficiency in the current system, "We lose quite an appreciable amount of time waiting to make blue prints, and thus lessen the efficiency of our department. This time is lost in various ways, i.e.; running to see if the print is finished, pulling it in out of the storm, finding it too dark to print, the building casting a shadow on the frame and causing an uneven print. This will be done away with by the proposed installation.

argument to Lawton was that with a new blueprinting machine, prints would be secured much quicker and at a lower price, enabling the entire process to run more efficiently.

Often, when implementing new technologies, the providing company would send a test unit to the site. Decision-making regarding these new technologies often spanned months, and sometimes years. For example, in 1913, Quincy looked to implement a new time keeping system. They had a specific idea in mind and looked to other companies to help them meet this goal. This new system was partially based on the systems of other mining companies, with whom Quincy communicated with to find the “best” system for their needs[60]. McLain also wrote to many time clock companies, looking to see if Quincy’s needs could be met. After obtaining and testing multiple clocks, some would be sent back as definitely inferior[61] while others they worked with to modify with the company.

When we print in the winter time, it requires from 10 to 30 minutes exposure to get the desired results. The proposed installation will secure results in not over 4 to 5 minutes.
The securing of blue prints of a uniform color, which will cause a perfect matching when our prints are pasted together – this would improve our large maps 50%.
The making of blue prints at any time of day or night, regardless of the condition of the outside weather, and also on short notice. The following is an example of the benefits to be derived along this line. The other night I made a drawing for the machine shop, for which it was highly important that a casting be made as soon as possible. I made the drawing, but was unable to secure a print until next day, and then only by an exposure of about two hours. By the proposed installation, we could have had a print that night” (MTUA/CCHC, Collection MS-001, Box 365, Folder 047).

[60] In February 1913, McLain wrote to the Newport Mining Company in Ironwood, Michigan enquiring about their time keeping system as Quincy planned to use their system as a model for their own (MTUA/CCHC, Collection MS-001, Box 350, Folder 007).

[61] On May 2, 1913 McLain wrote to the Follett Time Recording Company, regarding a time clock test, “We will return to you tomorrow the time clock shipped us for examination. I am sorry to advise you that it will not answer our purpose; this for several reasons.
First, the fact that the date stamp can be changed from the outside of the clock by a simple movement of the pencil.
Second, the lack of automatic changing of the month.
Third, the necessity for the time keeper having the key to open the clock for winding on the inside, thus enabling him to make any changes he desires.
For the uses we intend to make of the clock these objections would be fatal” (MTUA/CCHC, Collection MS-001, Box 350, Folder 007).

In the 1970s, many of the same items discussed in QMC correspondence were still present in the nearly abandoned office building. Objects like the blueprinting machine, about which Tenney DeSollar was so passionate, are still present in the office building. In 1978, an Historic American Engineering Record (HAER) project documented much of the Quincy Mining Company property on Quincy Hill. During that time, Theresa Spence, the archivist at Michigan Technological University (MTU) at the time, was granted access to the office, as well, after the report. She and Charles Hyde, a history professor at Wayne State University and co-leader of the HAER documentation project, went through the office room by room, documenting the office. According to Spence, "it was like when the mine office closed they just sort of shut the door and everything was still there[62]." The only change was that a local agency had moved into some of the rooms on the first floor and was using those spaces. At this time, Spence collected and documented much of the archival materials from the office and relocated them to the MTU archives for processing and storage.

The second floor and attic remained closed again until Fall 2001, when the Keweenaw National Historical Park purchased the building. Upon opening the second floor and attic, the KNHP discovered that, essentially, the second floor had been sealed off with everything still in place. The same was true for the first floor vault. Though there was little time for salvage because the objects needed to be collected before the end of the KNHP fiscal year, the objects' provenance was documented in the inventory. These objects then remained in storage until 2010, when KNHP was granted funding for a backlog-cataloging project, in which the author participated. From April 2010 through

[62] Theresa Spence, interview by Renée Blackburn. 28 Feb. 2011.

September 2010, nearly 700 catalog records were created, totaling over 6,000 objects.[63] The layout of the first floor – who worked where – is well established throughout QMC's operation of the office. However, the second floor and attic are not well documented. Using the object's locations at the time of removal in 2001, analysis of the second floor and attic workspaces can be recreated.

Scientific Management in the Quincy Mine Office

By the early 1910s, Quincy's use of scientific management techniques had been ushered in by college-educated Lawton, who trusted in his also college-educated workforce. Lawton hired six college-educated efficiency engineers within the first decade of his time as Quincy general manager (Lankton 1991). These engineers were not only working in the mines, gaining the respect and credibility of the mine workers, but also in the office setting. As business grew, the amount of paperwork in the office also grew. Lawton's implementation of scientific management techniques and the hiring of efficiency engineers redefined the office environment. Originally, the Quincy office housed minimal operating functions. The general manager had an office, as did his top people, such as the purchasing agent and head engineer. However, as scientific management principles began to take hold, the space needed to be redefined.

Unlike C&H, Quincy could not grow outward as no additional changes to the exterior of the building were made. Instead, they needed to be creative with the interior

[63] Each catalog record can, in theory, contain multiple objects. For example, KEWE 3615 and KEWE 3616 are cataloged as a stamp drawer with stamps. For the stamp drawer, KEWE 3615, each component is given a letter, beginning with a, because the drawers can be removed from the unit. So, the drawers are labeled In the case of KEWE 3616, the stamps are not individually given a letter, but instead were counted and all assigned the KEWE 3616. In total, there were 3,443 stamps in the stamp drawer.

spaces available. In the 1910s, both the library and the workers' pay windows were decentralized and moved out of the office. Though the receiving of pay no longer happened in the office, the accounting processes associated with it grew and remained inside the building. This change also allowed for Lawton and his efficiency engineers to create a new Employment office. Instead of workers going to each of the sites – the mill, the smelter, the mine, for example – the workers would now come to one place. Thus, the task of gaining employment became "scientific," as there was a set way to gain employment at any of the mine's operations.

The entire pay system at Quincy was not new to change, as the way in which time was recorded changed in the early twentieth century. McLain often wrote to time recording clock companies, attempting to find the best clocks in order to help Quincy create the most efficient system of time keeping. This interest in time keeping matters played directly into the scientific management ideas infiltrating the mining industry. Quincy wished to create efficiency in all steps of the work process, including in seemingly minor areas like time clock records. This detail also stretched into the work of the engineers in the office. Tenney DeSollar, head engineer for Quincy, expanded engineering operations from the second floor of the office into the attic space. In the attic, Quincy was able to create an efficient darkroom and blueprinting process area. The utilization of the attic space coupled with the updated blueprinting machine streamlined the engineering and drafting processes in the office. As the importance of the engineering department grew at Quincy, it only made sense that the size of the operations would also need to grow, and in that structure, the only way to go was up.

The Quincy Mining Company Office Today

The QMC mine office building is a two-and-one-half story mass of Richardsonian stone masonry located across the highway from – and facing – the company's main concentration of buildings (Figure 4.13). The office contains two stories, a basement, and an attic with a tall ceiling. In appearance, the building looks heavy on the landscape, due to its large, dressed sandstone construction. The front façade of the building is broken into three main bays, with a protruding center bay with covered porch (Figure 4.14). The north and south elevations are nearly symmetrical in terms of window placement, while the back façade is reminiscent of the front façade. There are three main bays, and the center bay has a covered porch and a pediment/dormer with a small window from the attic.

Figure 4.13: Front elevation of Quincy Mining Company office. Photograph by author, 2010.

Figure 4.14: Close up of center bay of Quincy Mining Company office. Photograph by author, 2010.

The first floor on the front of the building has two large Richardsonian, symmetrical arched windows in each bay on either side of the center bay. These windows each have two one-over-one double hung sash windows. In the center bay, a double set of pillars sit on the corners of the porch, supporting the roof structure of the porch. A cement walkway and steps lead up to the double front door. The second story is separated from the first by a decorative watercourse. There are three sets of one-over-one double hung sash windows above the arched windows in the two side bays and the porch in the center bay. These second story windows are less ornate than the first story windows, which are surrounded by an arch of sandstone. Instead, the second story windows are recessed into the stonework. Additionally, the widow's walk on the second floor has a small fence around the edge, with pillars in the corner reminiscent of those on the first floor porch. A triangular dormer sits atop the roof, directly over the porch, with a small arched window that echoes the style of the large arched first floor windows.

The north and south side elevations of the building are almost symmetrical in terms of window placement. The north end first floor contains a large arched window near the front of the building. This window, and its match on the front, is in the general manager's office. However, the other two windows on the first floor are not similar. There is a small window, which corresponds to the location of the restroom, and then a single pane window. On the second story, the window above the general manager's office is the same as the second floor windows on the front of the building. The other two windows are not similar, as one is a long, narrow single pane frosted glass, partially covered at the top, and the other is a single one.over.one double hung sash window. The south end of the building is symmetrical but does not match the window placement of the north end. The south end was very similar to the front in that there were two first floor arched windows with double one-over-one double hung sash and the second floor has double one-over-one double hung sash windows.

The rear façade was very similar to the front (Figure 4.15). It also consists of three bays, with a prominent central bay. There are two sets of arched first floor windows with corresponding double windows on the second floor. There is also a dormer with a small arched window reminiscent of the arched first floor windows. One of the main differences here is the porch system. Now, there is an enclosed porch whose base is made of sandstone, like the rest of the building, but the porch itself is enclosed in wood. The windows above the porch consist of two separate single one-over-one double-hung sash. The hipped roof is steeply pitched and has symmetrical chimneys on the north and south ends. Where the four edges of the roof meet, there is a decorative wrought iron widow's walk.

Figure 4.15: View of rear and south sides, Quincy Mining Company office. KNHP construction on the rear covered porch. Photograph by author, 2010.

This building stands tall on the landscape and, from the front porch, second story central bay windows and attic window, displays a vast view of the surrounding industrial landscape. Situated near the top of Quincy Hill, the office can be seen from many points across Portage Lake, though not from Hancock itself. Though the trees once stripped from the landscape here have returned, the office is visible throughout the year, though barely, in the spring and summer months.

The interior of the office did not change significantly over time (Figure 4.16, Figure 4.17). Some modifications were made in the early 20th century, including the removal of pay windows. The interior is broken into three bays, which follow the lines of the exterior bays. The central interior bay consists of the hallway system, vault, and the back room, which has access to the rear façade porch. The north side bay is comprised of the large general manager's office, which takes up the entire northeast corner of the office (Figure 4.21). This room's windows allow for anyone in the room to see the majority of Quincy's property and out over the Portage to Houghton. The stairs to the second floor and basement, the restroom, and another office create the rest of the north bay. The south bay is similar to the north. It is comprised of two large offices, connected to each other, with vault access (Figure 4.19, Figure 4.20, Figure 4.21, Figure 4.22). Beneath the stairs to the second floor is the entrance to the basement. The basement has a cement floor and also another vault with wood shelving.

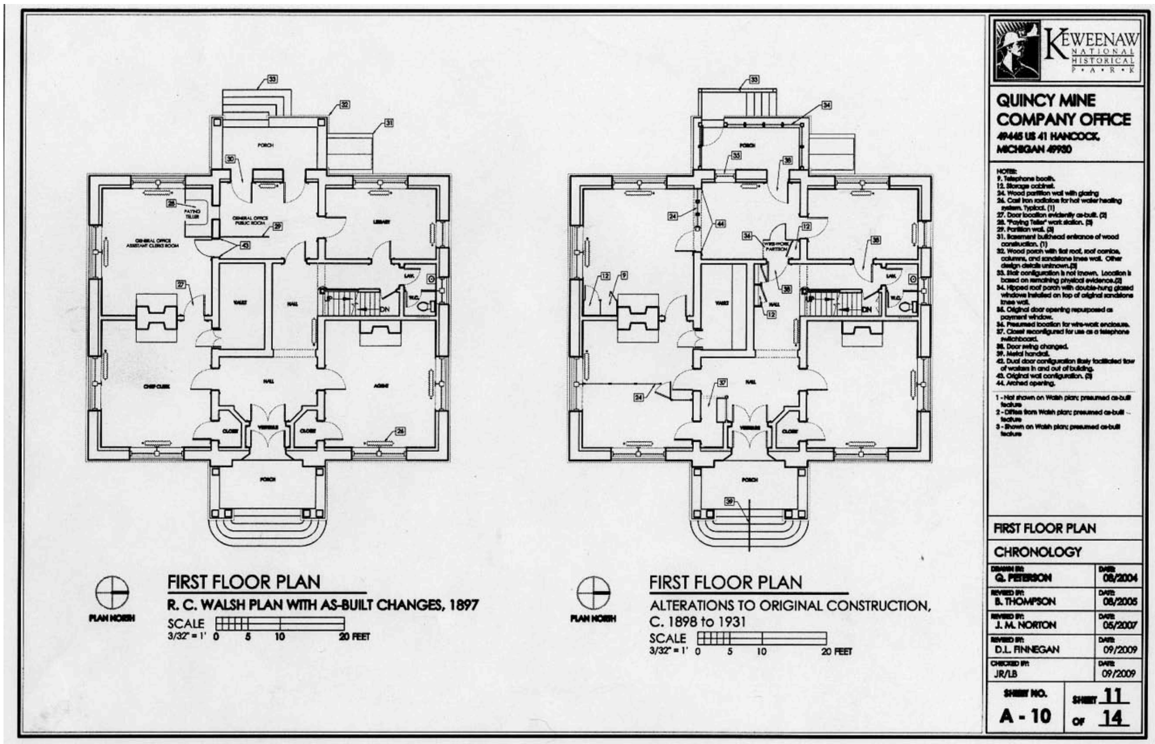

Figure 4.16: Drawings of original construction and alterations made in early 20th century on the first floor of the QMC office. Note the removal of the pay windows in the southwest corner. Image courtesy of KNHP.

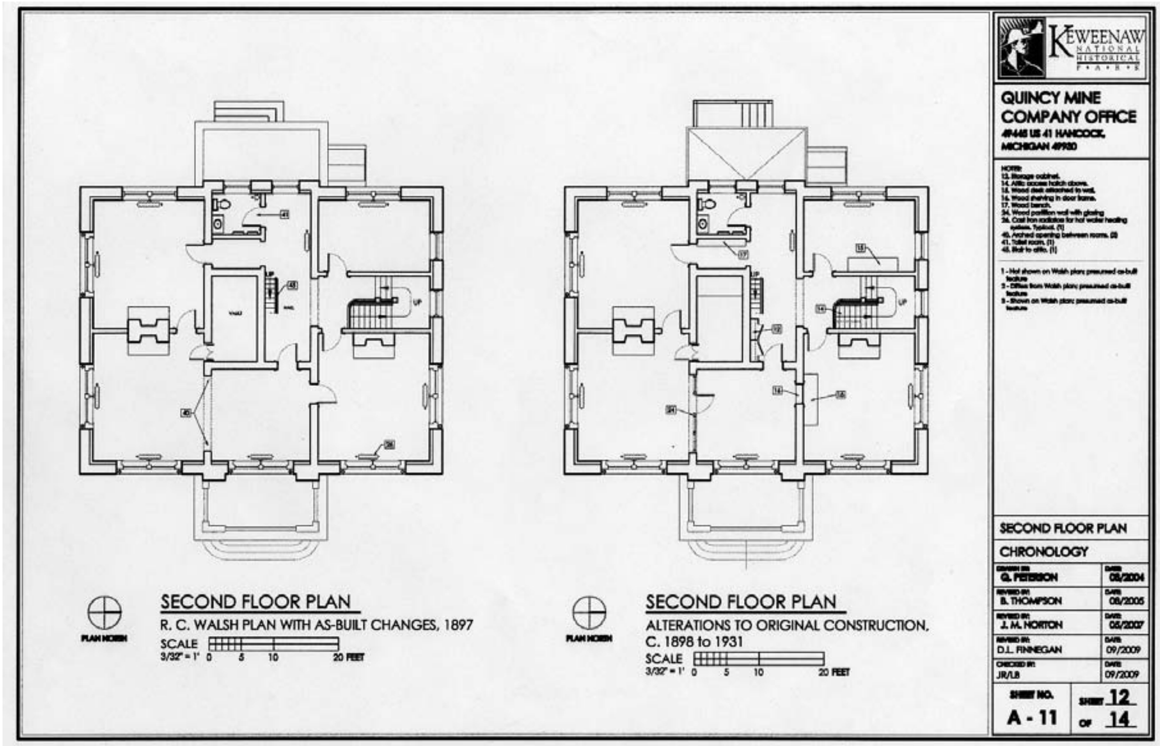

Figure 4.17: Drawings of original construction and alterations made in early 20th century on the second floor of the QMC office. Little was modified, with the exception of doorway changes in the front three rooms. Image courtesy of KNHP.

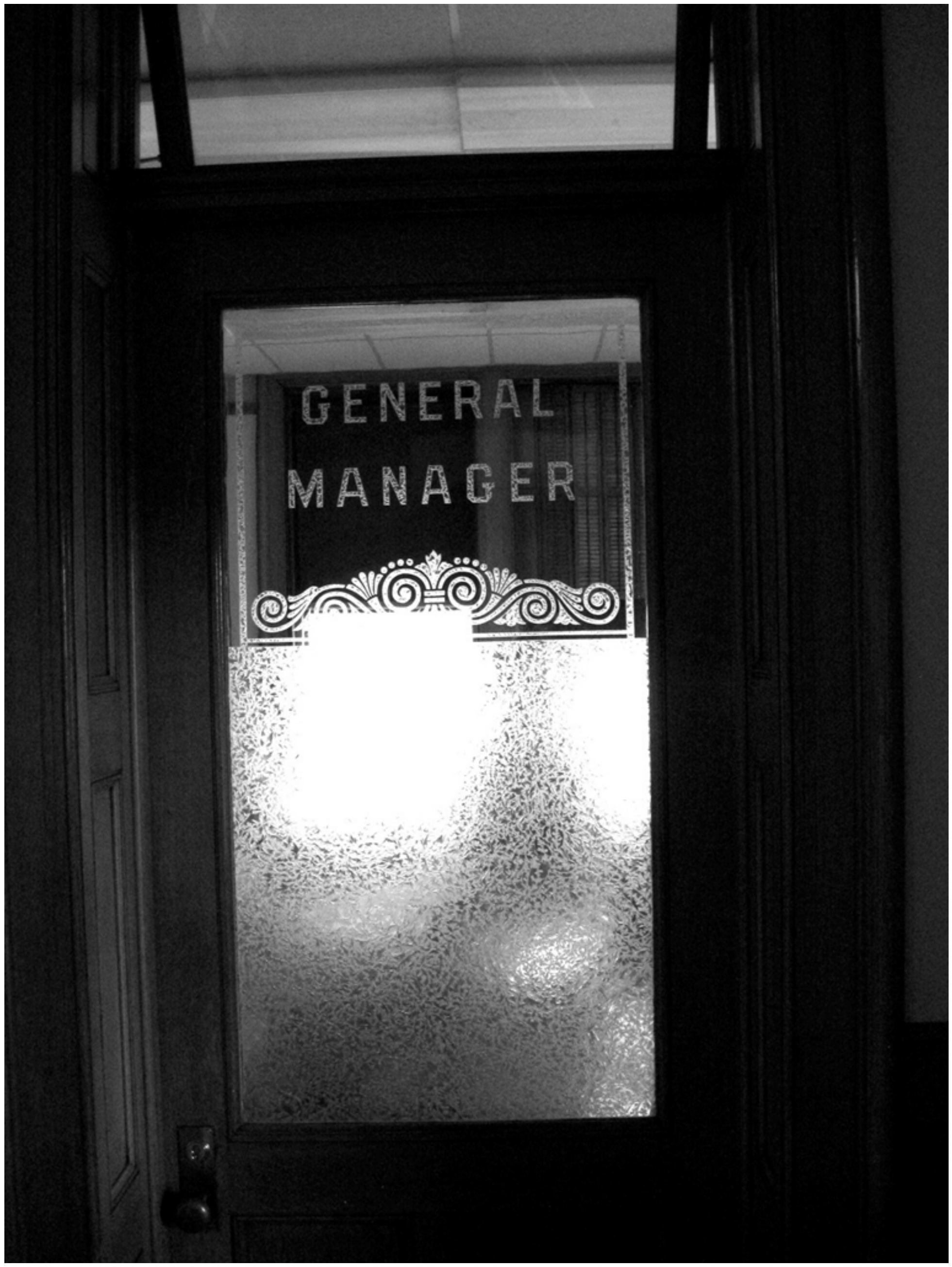

Figure 4.18: General Manager’s office door with frosted glass design. Photograph by author, 2010.

Figure 4.19: Early 20th century image of fireplace in clerk's office. Image courtesy of MTUA/CCHC image # Acc.03.095D.001.007.

Figure 4.20: 2010 image of fireplace from Figure 4.19. Photograph by author, 2010.

Figure 4.21: QMC office first floor vault door, located in Clerk's office. Photograph by author, 2010.

Figure 4.22: Interior of first floor vault with built-in custom storage from the Baker-Vawter Company. Photograph by author, 2010.

The second floor also follows the three bay scheme. The staircase to the second floor bisects the north bay, which consists of two offices on either side of the staircase (Figure 4.23, Figure 4.24). The center bay, again, contains a hallway with access to multiple rooms. In the center of the center bay is the second floor vault along with a narrow staircase to the attic (Figure 4.25). A second floor restroom is located in the rear of the center bay. The south side bay mirrors the first floor south bay. There are two large rooms, connected to each other, with vault access. With the exception of one room, all these rooms have fireplaces.

The attic stairs are very narrow, and at the moment, the attic floor is covered with nearly two feet of insulation (Figure 4.26). Though it is an attic space, the room is large and the ceiling is high. Eventually the blueprinting and darkroom moved to this space and the original blueprinting machine is still located in the attic. The only natural light comes from the two dormer windows, which also provide a nice view of Portage Lake and Houghton, though nothing else can be seen from this level.

Figure 4.23: Second floor landing, looking over staircase to first floor. Photograph by author, 2010.

Figure 4.24: Purchasing Agent's fireplace. Second floor, room 205. Each "important" room had a fireplace, each was unique compared to the others. Photograph by author, 2010.

Figure 4.25: Narrow staircase to attic. Located in center bay of second floor. Photograph by author, 2010.

Figure 4.26: The attic space of the QMC office, with the floor covered in insulation. Note that there is a large drafting table in the rear of the photograph that could not be removed by the KNHP upon salvage of the office building in 2001. Photograph by author, 2010.

CHAPTER FIVE

VIRTUAL EXHIBIT

As part of the Keweenaw National Historical Park, the Quincy Mining Company office is ready for interpretation. While KNHP's plans for interpretation eventually include creating an on-site interpretive exhibit, creating a virtual exhibit space for visitors is essential to the interpretation of the office[64]. Though this exhibit is meant to focus only on the office, ignoring the surrounding physical landscape would be of great detriment to understanding the structure of the office, both internally and externally. Understanding how the exact placement of the office and the fine details of its interior and exterior helps the viewer better grasp just what the office meant to the company and the community. Also, recreating the interior and exterior of the office in the early twentieth century will allow visitors to view the office on a deeper level which will facilitate the spread of memories regarding the Quincy Mining Company office and other operations.

Defining the Virtual Museum

The origins of the virtual museum, according to Erkki Huhtamo, are based in the early twentieth century changes in exhibit design by artists who adapted "new" media technologies, like "photography, film, and sound recording," into exhibits that were more visitor-centered (Huhtamo 2002:3). These artists looked to change the way in which the public experienced the museum. Instead of the museum being a place to view artwork, they wanted visitors to engage with what they were experiencing. This new focus on the

[64] Brian Hoduski, interview by Renée Blackburn, 7 Mar 2011.

museum experience as interactive developed out of early twentieth century movements like Futurism[65].

This eventually developed into the use of virtual reality to intensify the museum experience by treating the visitors as agents able to create their own meaning within the museum space. Specifically, exhibit design has turned into a new language that includes the virtual world along with other forms of technology to form a complex system that allows the visitor to interact with the museum on a new level. Huhtamo (2002) claimed that the key to this is the integration of new and different types of media, as well as integration between the "new" museum and the old, traditional museum setting.

The creation of a virtual exhibit within a museum setting, however, bears the question, what is a virtual museum and how does this fit into the existing world of the museum as an institution? Werner Schweibenz offered a working definition for the virtual museum, which for the purposes of this exhibit, will be used. Schweibenz stated that the virtual museum is defined as, "a logically related collection of digital objects composed in a variety of media which, because of its capacity to provide connectedness and various points of access, lends itself to the transcending traditional methods of communicating and interacting with visitors…; it has no real place or space, its objects and the related information can be disseminated all over the world" (Schweibenz 2004:3).

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[65] Huhtamo stated that Futurism played a major role in the development of experiential exhibits that would continue to influence museum exhibition in the late 20th century, particularly in the virtual museum realm. Huhtamo included a quote from F.T. Marinetti (1913), an Italian Futurist, that expressed Huhtamo's arguments, "Futurism is grounded in the complete renewal of human sensibility brought about by the great discoveries of science. Those people who today make use of the telegraph, the telephone, the phonograph, the train, the bicycle, the motorcycle, the automobile, the ocean liner, the dirigible, the aeroplane, the cinema, the great newspapers (synthesis of a day in the world's life) do not realize that these various means of communication, transportation and information have a decisive influence on their psyches" (4).

Overall, the goal of the virtual museum setting is to "preserve this content for future generations and support its use and management over time" (Schweibenz 2004: 3).

To develop a successful virtual museum as a counterpart to a standing institution, Jonathan Bowen (2000) offered several tips. One of Bowen's first claims was that a virtual museum should not merely be a recreation of an actual standing institution. Instead, the virtual museum should provide visitors with the opportunity to see features of the museum to which they would normally not have access. Bowen also made a statement regarding the point of view of the visitors. He claimed that, "a popular reason for searching a museum Web site is to learn about a museum that may be located far from where the virtual visitor lives" (Bowen 2000:4). This then has the potential to draw a visitor to the physical site to see it in person. This also means that the virtual exhibits should, in a way, mirror those of the physical museum. Doing this would allow the virtual exhibit to add more depth and detail to what may not be possible to see at the standing institution. These features must all be taken into account when preparing a counterpart virtual museum experience for visitors, whether it is via the Internet or at kiosks at the museum.

Creating Meaning and Place in the Virtual Museum World

Museums are often viewed as institutes of memory, wherein the public trusts the museum to forever be the keeper of history. In this case, the museum acts as a repository for history, in which history is defined by the academic world and seen as the ultimate truth by the museum visitor. Recent developments in museum exhibition have modified that experience, causing an uneasy feeling amongst visitors who are now expected to aid in the memory and history making process of the museum. Susan Crane (1997) discussed this issue as “distortion” between memory and history and what is expected of a museum by the visitor.

During this shift in what is expected of both the museum and the visitor, the ability to allow the visitor agency to create their own interpretations of history can cause the visitor to feel as if the museum has not met their expectations. They may feel that they learned nothing, though Crane stated, “by challenging visitor expectations, and therefore the memories associated with previous museum visits, the exhibit offered visitors the opportunity to create new meanings for themselves” (1997: 45).

Although this may make both visitors and curators nervous, the ability for the visitor to interact and create new memories only adds to the museum experience. Though the museum may be seen as an objective display of history, the reality is that the objectivity assumed is subject to the subjective interpretations of all involved in the process – from exhibit designer to museum visitor. As museums attempt to push visitors beyond the “expected” cultural boundaries of the museum, visitors will often react in negative fashion, expressing their negative feelings towards the exhibit in question. Often this occurs in regard to subject matter that still causes strife in the memories of the potential visitors. Crane used the Enola Gay exhibit at the National Air and Space Museum as an example. This exhibit portrayed two very different histories, each of which was contentious. In the first, the Enola Gay was seen as the airplane that brought about the nuclear age; while in another, it was seen as the destroyer of two Japanese cities (Crane 1997). In the case of contentious history, the virtual exhibit world has potential to act as a mediator, displaying both sides of the story in a way that would not be easily possible in the standing museum.

Digital media in the museum sector is not a new concept, but one that has been discussed since the late 1960s.[66] At the end of the 1990s, when the use of the Internet became more widespread, museum professionals began to discuss more openly the possibilities for the introduction of digital media and the Internet into the museum world as a way to enhance the on-site visit[67]. Though the museum would be losing some control over the visitor's experiences by allowing access off-site, digital media allowed for new interpretations to be made of museum collections. This new media technology also creates a shift from "object-centred" design to "experience-centred" design, which helps the visitor create new meanings from material objects (Parry 2007:81). Visitors will be able to experience the museum on their own terms, at whatever hour of they day they please, moving as slowly or as quickly as they see fit while also breaking down physical and social barriers that may be in place, hindering on-site visitation. Though no longer physically experiencing the museum site, visitors are creating new communication with each other and the exhibit via the Internet.

Andrea Witcomb (2007) described the introduction of multimedia into the museum world as the catalyst for two opposing viewpoints. The first, in where museums

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[66] In the late 1960s and 1970s, the use of computers in the museum world was mostly for museum cataloging. See Smithsonian Institution (1967) "Proposal for Research and Related Activities Submitted to the US Commissioner of Education for Support through Authorization of the Bureau of Research: An Information Storage and Retrieval System for Biological and Geological Data," 9 May, Smithsonian Institution Archives, accession 95.169, box 1; or Scholtz, S. (1974). Data Structure and Computerized Museum Catalogs, Museum Data Bank Research Report no. 2, New York: Museum Data Bank Committee.

[67] David Anderson's 1999 report, "A Common Wealth: Museums in the Learning Age," stated that "It is probable that technology will not undermine but stimulate the public's desire to have a gallery experience; the virtuality offered by new media may balance and complement, rather than erode, the actuality that is to be found in real human relationships and contact with authentic objects in museums." Quoted in Parry 2007:70.

embrace technologies like the Internet, paves the way for new kinds of interpretation of material culture and, in a way, moves the idea of the museum forward. Instead of museums being places of "high" culture, new technologies help to make the museum a more accessible learning environment. On the other hand, there is the view that integrating new multimedia technologies into the museum world threatens the institution of the museum and its meaning. Through these two opposites, Witcomb attempted to show that the real issue at hand here is the significance of new technologies into the museum itself. Her stance was one of opposition to the opposition. She believed that a reluctance to trust and integrate new technologies will do more harm than good to the museum world.

One main point Witcomb made is the treatment of technology as the "other." She claimed that multimedia when viewed as an interpretation tool only means that the museum is shortsighted. Instead, looking at multimedia in museums as a way to create new affectual experiences would allow for different interpretations by the public of objects and, perhaps, spaces[68]. Witcomb used case studies of actual multimedia exhibits that stand-alone and are not only a piece of a larger, traditional exhibit to prove her point. She claimed that multimedia exhibits can create a new experience and a way to open up dialogue regarding contested history.

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[68] Regarding the value of digital media to the world as a whole, George MacDonald wrote, "values, attitudes, and perceptions that accompany the technological transition from industrial to information society can make it possible for museums to achieve their full potential as places for learning in and about a world in which the globetrotting mass media, international tourism, migration, and instant satellite links between cultures are sculpting a new global awareness and helping give shape to what Marshall McLuhan characterized as the global village." MacDonald, George. 1996 Change and Challenge: Museums in the Information Society. *In* Museums and Communities: The Politics of Public Culture. I. Karp, C. Mullen Kreamer, and S. D. Lavine, eds. Pp. 158-181. Washington, D.C.: Smithsonian Institute Press. Quoted in Whitcomb 2007:38.

Witcomb pointed out that the introduction of multimedia, like the Internet, has created a new museum, where multimedia and traditional exhibition coexist. This, then, has turned the museum into a space that provides “both intellectual and physical access” to the material culture through a popular medium like the Internet (37). In this, the museum visitor is able to gain new knowledge and better comprehend the story being told. Multimedia exhibitions allow the visitor the ability to learn via multiple senses, stating that to be most effecting, exhibits must elicit emotional and physical responses from the visitor. Though a multimedia exhibit, the visitor is given the opportunity to do more than look at an object on display, but instead can immerse themselves into the contextual landscape surrounding that object.

Focusing on material culture, Eilean Hooper-Greenhill (2000) discussed how objects could create new meanings within museum settings, beyond being merely displayed as parts of collections for visitors to see. Instead, Hooper-Greenhill suggested that objects be used as a way to create meaning but also allow the visitor to create meaning via personal experiences and understandings of culture. By allowing for meaning to flow both ways – from the museum curator’s creation of meaning to the visitor and vice versa – museums can create a new learning environment and relationship with visitors. To do this, both what is said and the way it is said is important when attempting to create meaning for an object and must be taken into account when recreating written or oral material to accompany objects.

In the case of museum exhibits, Hooper-Greenhill stated that these are created with an intended meaning in mind – though that meaning may not always be clear to the visitor. Exhibit objects, for example, must share an underlying associated meaning that is easily identifiable by the visitor, but at the same time, these same objects may fit into the overall message differently than expected by the museum curator. The meaning associated with objects will also vary widely based on who the visitor is and when they experience the exhibit. As Hooper-Greenhill stated, "The appearance of the object, how it looks and is perceived, varies according to how it is understood" (2000: 103). The influences of each visitor's social role and the events they are currently experiencing changes the meaning of an exhibit. Visitors need to create meaning based on their own personal experiences.

Further emphasizing the importance of immersion and sense of meaning and place in the digital world, Eric Champion and Bharat Dave (2007) discussed ways in which a sense of place can be evoked through digital media. They claimed that when using cyberspace to recreate history, the creator is thus attempting to recreate a place and wishes to provide the viewer with enough information to create their own sense of place within the virtual world displayed. By finding place within a virtual world, the visitor must have the ability to do more than look or move around. Thus, a virtual representation of place must be more agency-centered.

Though the recreation of a historical site via cyberspace still creates a "place," it is the creation of a place that evokes emotion or memory that makes it significant. At the same time, merely representing the landscape with the most realism and detail possible also does not create this sense of place. The visitor must be an active participant in the virtual world. Artifacts within it should communicate with the viewer. The authors used architectural design as an example akin to the creation of virtual space. With that, architects are not only focused on the structure they are creating, but also its surrounding landscape and the cultural meanings associated with that landscape and the functions of that structure in particular (Champion and Dave 2007). The same is true for the virtual exhibit world. In order for structures and landscapes to evoke emotion, they must be associated with their intended cultural meanings, but at the same time, be able to convey that meaning to other cultures.

The use of 3D video game software is a viable and easy option for museums to use to implement virtual exhibits. George Lepouras and Costas Vassilakis (2005) claimed that virtual reality would allow museums to present exhibits that they may not be able to do physically, due to space restrictions or material fragility. They additionally claimed that it would be beneficial in cases where "there is a need for visualising [sic] and stimulating environments, constructions or objects that no longer exist, be partially preserved or cannot be easily visited" (Lepouras and Vassilakis 2005: 96). Though the virtual reality world, virtual visitors would have the chance to interact with exhibits in ways that would not be possible in the actual museum.

Lepouras and Vassilakis used the "Virtual Museums" project as an example for the benefits of 3D video game technology in the museum world and discussed the steps used in creating a virtual museum. The "Virtual Museums" project was a program funded by the Greek Secretariat of Research and "aimed to explore the use of virtual reality technologies in the premises of museums," with a goal of helping both researchers and visitors obtain access to rarely-seen objects (Lepouras and Vassilakis 2005: 105). The project created two separate systems, one for researchers and a desktop version for the public. The latter system was created using the software Sense8's World Up, a program that has the ability to create a virtual world[69]. Multiple steps were then taken by museum staff in choosing exhibits and creating the virtual framework for the exhibit space, including floor plan and display spaces[70]. Once complete, visitors were asked to take a survey regarding the exhibit, many of which found the virtual exhibit environment "familiar, easy to use and stimulating" (Lepouras and Vassilakis 2005:105).

David Bodenhamer expanded upon the idea of creating memory through virtual space through the use of GIS software. Bodenhamer discussed the way in which GIS analysis is beneficial to recreating history. By incorporating a map of an area into a discussion of history, the informant is then able to recreate memories of that area that would otherwise be difficult to obtain. For example, Bodenhamer discussed an example where providing a map to a group of informants allowed them to create a detailed history of the area in question, that was not only influenced by the map but recreated within a "complex layer of memory and history" (2007:98). He claimed that, "people experienced the power of the map to evoke history and memory, to prompt narrative, to define community" (2007:99).

Furthermore, Bodenhamer expounded on the idea of using GIS in humanities and social science research. He claimed that GIS would enhance and offer a deeper understanding of history for the scholar, the informant, and the visitors. GIS software allows the analyst to recreate history through time and space, showing the visitor aspects of history that are no longer present in the real world. For example, Bodenhamer

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[69] http://www.terasoft.com/about/sense8.html

[70] Lepouras and Vassilakis (2005) list these steps as, 1. Exhibit selection; 2. Exhibition space design; 3. Selection of presentation methods; 4. Interaction design; 5. Exhibit digitisation; 6. Placement of exhibits within the exhibition space; and 7. Interaction programming (98).

discussed the use of GIS to recreate the Roman Forum[71]. In this, users are able to virtually walk through ruins as they would have existed at the time of their construction. A more complex use of GIS involves the CAVE project, which recreated nineteenth-century Morgantown, West Virginia[72]. In this, the analysts recreated a section of the town using Sanborn maps and photographs. In the CAVE project, the users could navigate through the virtual world of nineteenth-century Morgantown and experience it though multiple senses. Users can move through the town and through buildings, seeing and "touching" what material culture was present inside during the nineteenth-century. The project allows the visitor to feel like they are there through visual immersion.

Examples of Virtual Exhibits

There are multiple examples across the Internet of virtual museum exhibits. Some are extensions of physical exhibits at sites while others stand alone as their own exhibit. The Smithsonian Institute has a wide variety of virtual exhibits that complement their physical exhibit components. Though these exhibits are not in 3D, they have various components that allow visitors to experience the exhibit, rather than merely reading and looking at photos. For example, the "Within These Walls" exhibit at the National Museum of American History allows visitors to click on various sections of a photograph of a house to experience sounds and images from select time periods of the house's history[73]. Once clicked, the visitor has the choice to either continue and read more about that period, or click on another section of the house for a different story. By

[71] http://dlib.etc.ucla.edu/projects/Forum
[72] Information regarding the project can be found here:
http://www.esri.com/news/arcnews/winter0607articles/immersive.visualization.html
[73] http://americanhistory.si.edu/house

clicking to learn more about that time period, the visitor is then immersed more deeply into that world. By then clicking on the story of the Caldwells, for example, one loads a page with music from the early 1800s, images of objects associated with the family, and details regarding changes they made to the house. In this case, the exhibit looks at one building and its modifications through time architecturally and the social and cultural changes that occurred within.

Another Smithsonian Institute exhibit, titled “America by Air” at the National Air and Space Museum, explores the development of air travel throughout the twentieth century[74]. This exhibit is divided into multiple interactive sections, including activities and a place for visitors to share their own stories. Sections of the exhibit are text and photograph-only but the majority is experience-centered for the visitor. One of the activities is titled “Around the World in 18 Days” and allows visitors to recreate Herbert Elkin’s 1936 journey around the world in two different ways. First, visitors have the opportunity to look at the map and place the different sections of his trip in order. Once each section is placed correctly, a larger screen appears with more information regarding this section of the trip. The second option allows visitors to piece together bits of newsreel to create their own newsreel of his journey. By allowing visitors to essentially “recreate” history in their own way creates a new learning environment by which the exhibit acts as the catalyst.

Text- and photograph-heavy virtual exhibits also exist and are valuable to the learning process as well. In the case of the Early Office Museum, the creators have broken down the large category of office objects and created easy-to-navigate

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[74] http://www.nasm.si.edu/exhibitions/gal102/americabyair/activities/aroundworld/index.cfm

categories[75]. Within these categories, objects are sorted by type and listed in order of time. These categories mostly consist of sections of text with corresponding photographs of the objects. Another section of the Early Office Museum is a section of photographs from various time periods and countries showing the interiors of offices. This allows the visitor to first read about objects, then see them in use in old photographs, or see the photographs and then explore the objects.

A similar text- and photograph-heavy exhibit is "A Glimpse of the Past: A Neighborhood Evolves," at the National Portrait Gallery[76]. This exhibit consists of mostly text regarding historic buildings in Washington, D.C. What makes this exhibit interesting is the ability for visitors to look at the historic photographs and read about what the neighborhood was like in the past and to also see a modern photograph of that same building, or, if no longer standing, what is currently at the site. This allows the visitor to begin to comprehend the implications of time on a site, the importance, as demonstrated by the last slide in this exhibit, of historic preservation initiatives and, also in this case, how social changes can affect the organization of neighborhoods.

Though the previous examples did not include 3D visuals, there are some virtual exhibits that do. The 3D Museum, though not a history museum, is filled with 3D images of skeletons[77]. The website's goal is to "provide the pure enjoyment of looking at natural objects, mostly animal skeletons, in 3D," while also hoping "that it will trigger scientific interests among the visitors" (3D Museum 2009). The site is divided into multiple categories that allow the visitor to choose which section they would like to look at first.

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[75] http://www.officemuseum.com
[76] http://www.npg.si.edu/exhibit/glimpse/index.html
[77] http://3dmuseum.org

Within each section is a listing of different animals, with a photograph, description, and link to open a new window with the 3D image of part or all of its skeleton. Within the 3D window, the visitor can, using the mouse, move the skeleton around, looking at it from angles that would not be possible in a traditional museum setting. In this case, the visitor is able to create new meanings and have a different experience with the object than would be possible while looking at it in a case in a traditional museum setting.

The Remnants of an Industrial Past

The QMC office is one of the final remnants of the powerful history of a company that dominated the local landscape for over 100 years. Many of the other structures on that landscape are now merely open spaces with little to no vegetation or roofless masses that have little to no meaning to the common passerby. The landscape has become a victim of time as little remains. What was once a street lined with industrial structures and family dwellings now shows nothing of that original character. In this case, what the current state of the site cannot show is the industrial dominance of the company. This is where the virtual world can take over and recreate the large-scale mining operations that were known for many years.

Like a physical museum site, a virtual museum or exhibit also has its negative and positive characteristics. While a physical museum could impress upon viewers the results of the deindustrialization of Quincy Hill, a virtual museum can show both the old and the new. At the same time, a physical museum space has the ability to create more easily a sense of place for the visitor, to immerse them in the world of mining that once was present. This task, though possible, is more complicated in the world of the virtual exhibit. In this case, the visitor must be able to make connections beyond the visual with what they are experiencing. Breathing in the air inside a mine shaft may not be possible through a virtual exhibit, but creating a sense of this smell using words and sounds will help the visitor to delve deeper into the virtual world.

GIS Analysis of Quincy Hill

Creating meaning and place for the QMC office starts with the creation of a virtual exhibit space. A realistic 3D view of the surrounding landscape is vital to this effort. In doing this, and having the ability to recreate the QMC office landscape at different time periods will allow the visitor an opportunity that acts in sharp contrast to the current state of the QMC office and landscape. Recreating this landscape is accomplished through the integration of historic data, such as Sanborn Fire Insurance maps, coupled with present-day data, such as the digital ortho quarter quad of Houghton County.

In order to create realistic 3D buildings using ArcGIS software, the original Sanborn Fire Insurance maps first needed to be georeferenced to a current digital ortho quarter quad (DOQQ)[78]. The DOQQ was then projected into the Universal Transverse Mercator geographic coordinate system. The coordinate system, NAD27 UTM Zone 16N, was used throughout all aspects of the project. This work must be done in ArcMap, which allows the user to create new geospatial data from collected data. In ArcMap, the user can manipulate the data and create maps that represent these findings.

[78] The original digital ortho quarter quad was downloaded from the State of Michigan's Center for Shared Solutions & Technology Partnerships website, http://www.michigan.gov/cgi

Georeferencing involves matching points on a map without a geographic coordinate system, like the Sanborn maps, to known locations and points on another file with a geographic coordinate system. Once the basemap (hanc_utm) was set, proper preparation of the Sanborn maps was necessary. For Quincy Hill, the Sanborn map pages, which were available for 1900, 1907, 1917, and 1928, contained two different sections of the map on one page. Using ArcMap, each Sanborn map was clipped so that the sections would correspond to the correct section on hanc_utm. For each map, depending upon the number of splits necessary, a shapefile needed to be created that corresponded to the shape of the area to be cut out. Once the maps were clipped appropriately, then each could be georeferenced onto hanc_utm.

Though the Sanborn maps are drawn to scale, they are not always completely accurate. This is partially due to measurement errors during creation and partially to inherent errors when attempting to fit a digital flat, paper map to the curved, non-flat surface of the earth. Georeferencing the Sanborn maps showed some of these errors. Though some structures lined up nearly perfectly with their existing locations, others did not. This was also true across time, as there were discrepancies between the different dates. In some cases, the buildings would appear to line up with the existing structure, but when placing the georeferenced Sanborn maps on top of each other and analyzing the building locations, the slight discrepancies would be more apparent[79].

Although ArcMap allows the user to create 3D visuals, another ESRI ArcGIS program, ArcScene, is more useful to create 3D visualizations of small-scale landscapes. 3D visualizations create realistic representations of sites and also help to map features

[79] A description of the difficulties of using Sanborn maps in ArcMap to show historic changes in the landscape in Appendix A, while the flowcharts detailing the processes can be seen in Appendix B.

that would not be visible or meaningful in a 2D representation. For this project, a small section of Quincy Hill was sampled, using the DOQQ (hanc_utm) as the virtual exhibit's starting point. In order to create 3D elevation differences, a 10.meter digital elevation model (DEM)[80] was placed underneath the DOQQ. The DEM is a representation of the elevation of the earth's surface. Within ArcScene, in order for the DOQQ to represent elevation, it must be draped over the DEM. By doing this, the DOQQ then takes on the 3D characteristics of the earth's surface.

After creating the base layer, the structures must be created on the landscape. The DEM only contains elevation information for the earth's surface, not for any man-made structures. This creates inherent problems, especially for buildings that no longer exist on the landscape but are important to represent in the virtual exhibit. In the case of Quincy Hill, the Historic American Engineering Record (HAER) documented some of the buildings on the landscape in the late 1970s.[81] However, for the remaining buildings, other documentation was sought. The MTU Archives and Copper Country Historical Collection have a large selection of drawings from QMC. Many of these drawings were copied into the HAER documentation. In order to determine appropriate heights for each building, a combination of known measurements and Sanborn map notations of building stories helped identify probable building heights.

For example, the height of QMC No. 2 shaft-rock house, according to the HAER documentation, is 44.38 meters at its tallest point. The Sanborn maps show that No. 2 is 9 stories at its tallest point. By dividing the 44.38 meters by 9, the height of each story

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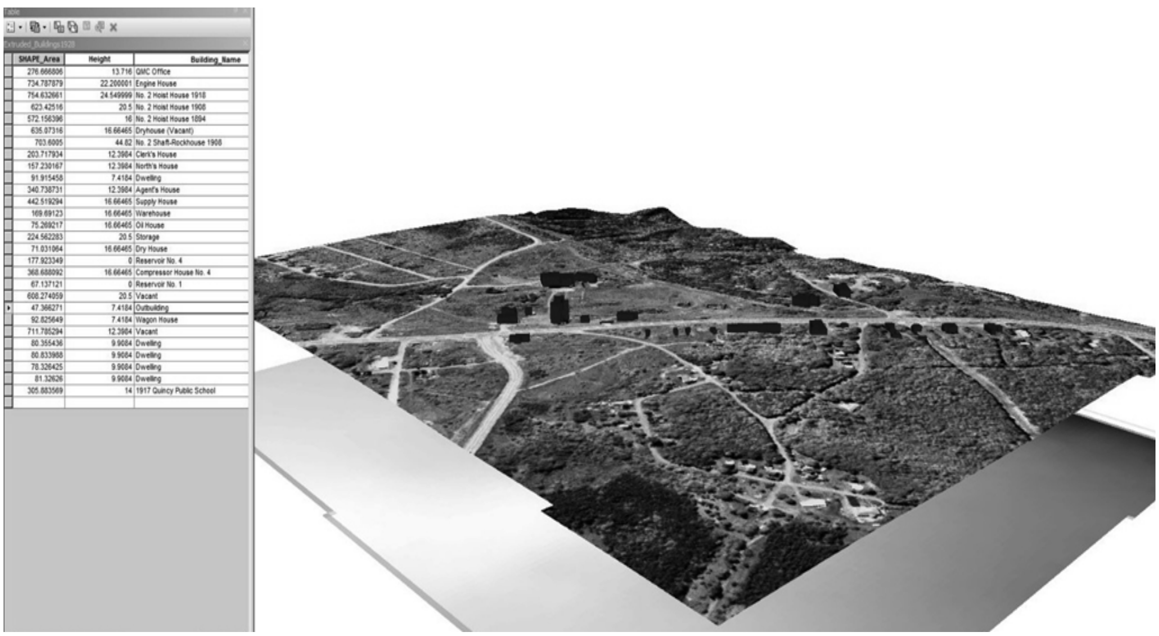
[80] The digital elevation model (DEM) was downloaded from the State of Michigan's Center for Shared Solutions & Technology Partnerships website, http://www.michigan.gov/cgi

[81] The HAER documentation for Quincy Mining Company can be found on the Library of Congress' American Memory Project website at http://memory.loc.gov

became 4.93 meters. Assuming that Sanborn considered a story as a standard form of measurement, then it is safe to use the 4.93 meters to determine heights of other structures. Though these measurements are not 100% accurate, when translated into the virtual world, it will keep the structures on the landscape within a scale that will more accurately represent the real-world situation.

Figure 5.1: 1928 Sanborn map with georeferenced structures. These structures will create the basis for digitizing the polygons that will be used in ArcScene. The location of the office is outlined by the black box. Created in ArcMap by author.

Once the heights for the structures were determined, those structures on the Sanborn maps were digitized using ArcMap (Figure 5.1). Doing this allowed each structure to be a separate entity in the attribute table of the digitized buildings file. Once this step was complete, the digitized building files for each of the four years were opened in ArcScene. In order to create the 3D image, a height field needed to be added to the attribute table of each file. A building name field was also added so that the structures could be labeled (Figure 5.2).



SHAPE_Area	Height	Building_Name
276.666806	13.716	QMC Office
734.787879	22.200001	Engine House
754.632661	24.549999	No. 2 Hoist House 1918
623.42516	20.5	No. 2 Hoist House 1908
572.156396	16	No. 2 Hoist House 1894
635.07316	16.66465	Dryhouse (Vacant)
703.6005	44.82	No. 2 Shaft-Rockhouse 1908
203.717934	12.3984	Clerk's House
157.230167	12.3984	North's House
91.915458	7.4184	Dwelling
340.738731	12.3984	Agent's House
442.519294	16.66465	Supply House
169.69123	16.66465	Warehouse
75.269217	16.66465	Oil House
224.562283	20.5	Storage
71.031064	16.66465	Dry House
177.923349	0	Reservoir No. 4
368.688092	16.66465	Compressor House No. 4
67.137121	0	Reservoir No. 1
608.274059	20.5	Vacant
47.366271	7.4184	Outbuilding
92.825649	7.4184	Wagon House
711.785294	12.3984	Vacant
80.355436	9.9084	Dwelling
80.833988	9.9084	Dwelling
78.326425	9.9084	Dwelling
81.32626	9.9084	Dwelling
305.883569	14	1917 Quincy Public School

Figure 5.2: 1928 Sanborn map structures created with Height and Building_Name fields. Created in ArcScene by author.

Using the Sanborn maps, determining the labels and heights for each building was relatively simple. However, some information regarding time periods of construction of certain structures was available from the HAER documentation. Recreating a 3D model of each building for each of the four Sanborn maps, 1900, 1907, 1917, 1928, allowed for color-coded analysis of the buildings from each time period (Figure 5.3). This then allows for easier understanding of the changes over time.

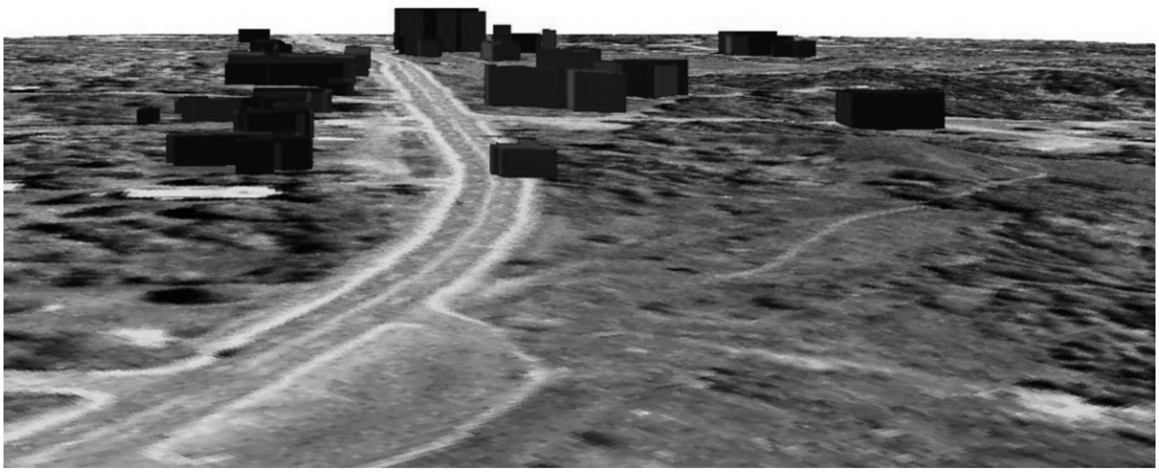


Figure 5.3: 1907 and 1928 Sanborn map structures, almost at street level. Created in ArcScene by author.

To facilitate an interactive experience with the visitor and to show them the changes of the landscape over time, the analyst can associate time with each attribute. For each structure, "Year" and "Year_End" fields were created. The "Year" field contained the year in which the attribute in question was built. The "Year_End" field was slightly different. If the structure in question was no longer present on the Sanborn map, then the end date would be the next Sanborn year. For example, a structure present on the 1917 Sanborn map that was not present on the 1928 Sanborn map would have an end date of 1928.

To set the time, there is an option in the properties of each layer that allows one to do so. Under the "Time" tab, the analyst can then enable time on the layer and either associates a single time field only or a start and end time field for each attribute. In the case of Quincy Hill, a start and end time were associated with each field. Using the software's "calculate" option created a thirteen-year time step interval, in which change would be shown on the time scale every thirteen years from start to finish. Since some of the structures present on the Sanborn maps were constructed in the 1860s, the time scale begins there. However, much of the change can be seen at the 1899, 1912, and 1925 intervals, with a 2003 interval showing the current state of Quincy Hill (Figure 5.4, Figure 5.5, Figure 5.6, Figure 5.7).

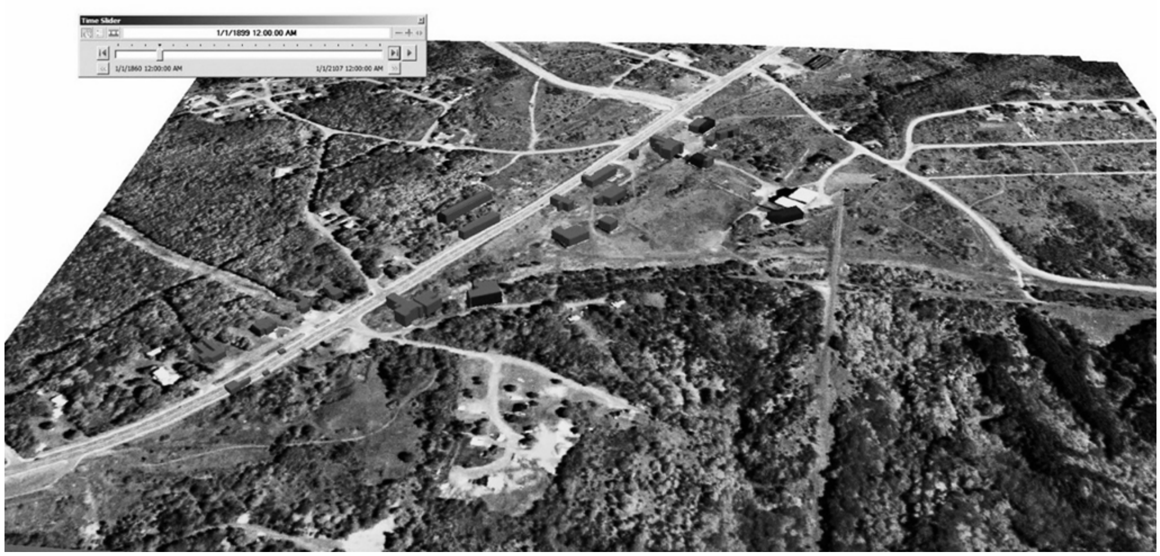


Figure 5.4: View of Quincy Hill structures ca. 1899. Created in ArcScene by author.

Figure 5.5: View of Quincy Hill structures ca. 1912. Created in ArcScene by author.

Figure 5.6: View of Quincy Hill structures ca. 1933. Created in ArcScene by author.

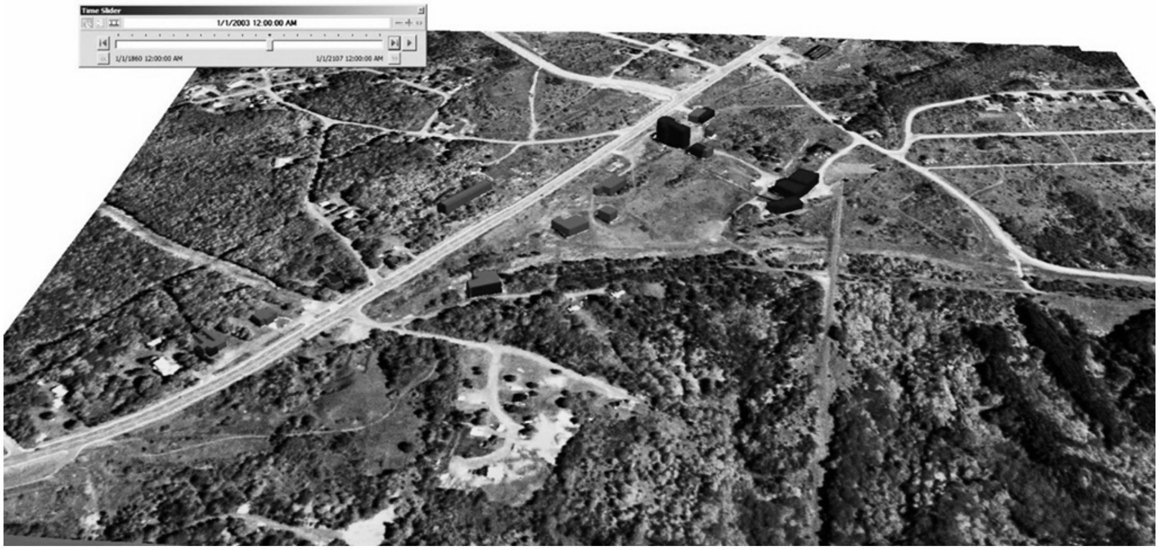


Figure 5.7: View of Quincy Hill structures ca. 2003. Created in ArcScene by author.

The ArcScene program also allows for the creation of animation videos. Of particular importance to this project is the creation of a time interval video, which would show the addition and subtraction of structures during the time period at hand. Additionally, ArcScene can create a “flyby” video, in which the viewer is able to fly through the landscape, experiencing it from above or from ground level. This provides a view of the landscape at a particular point in time and is especially valuable in cases where many structures are now absent from the landscape, as in the case of Quincy Hill. Though this is true, there are also limitations to the program itself, specifically in the creation of 3D structures. In ArcScene, one cannot create roof angles or place “realistic” structures on the map. Instead, the structures are 3D flat topped, single colored blocks on the landscape that have the general outline of the structure but not any of its details. To create roof angles, a separate software package must be used to create the structures (Figure 5.8). However, with appropriate roof heights and other features, ArcScene does offer the ability to then “drape” images of the structures over the layer and create a realistic view of the landscape. To add additional interpretive layers to the 3D view, there is also the potential to create “hyperlinks” where users would be able to click on various aspects of the landscape and see different information regarding the structure in which they clicked. These features can include images, audio or video files.

Figure 5.8: Digital recreation of QMC office on left, with photograph of QMC office on right. Digital recreation can be inserted into ArcScene. Digital recreation courtesy of Mark Dice, 2011; Image on right, Photograph by author, 2010.

Creating a Virtual Exhibit for the Quincy Mining Company Office

The virtual exhibit is meant to either stand alone as its own entity or supplement an exhibit inside the Quincy Mine office. The main emphasis of this exhibit is to show change over time not only of the office, but also of its surrounding landscape. This exhibit must create a connection with its viewers, so that each person has the ability to interpret, interact, and immerse themselves into the daily operations of the Quincy Mining Company office. There will be various methods used to recreate this virtually, including both historic and recent photographs, correspondence and other letters from the office, audio recordings, video recordings, and material culture.

Within the structure of the virtual exhibit regarding the QMC office must be the importance of the roles of each person involved in operating the company. Though there is potential for visitors to assume, beforehand, that the mine office work consisted only of how to deal with labor unrest at the mine and surface plants, in reality, various types of work happened in the office – from typing to drafting to accounting. Each person in the office had their specific tasks and those tasks overlapped with the work of others to create the complex operating system that kept the mine, its surface plants, plus the smelter and mills, operating while also managing housing properties, sales, and the intricacies of determining how to continue mining a quickly depleting copper supply.

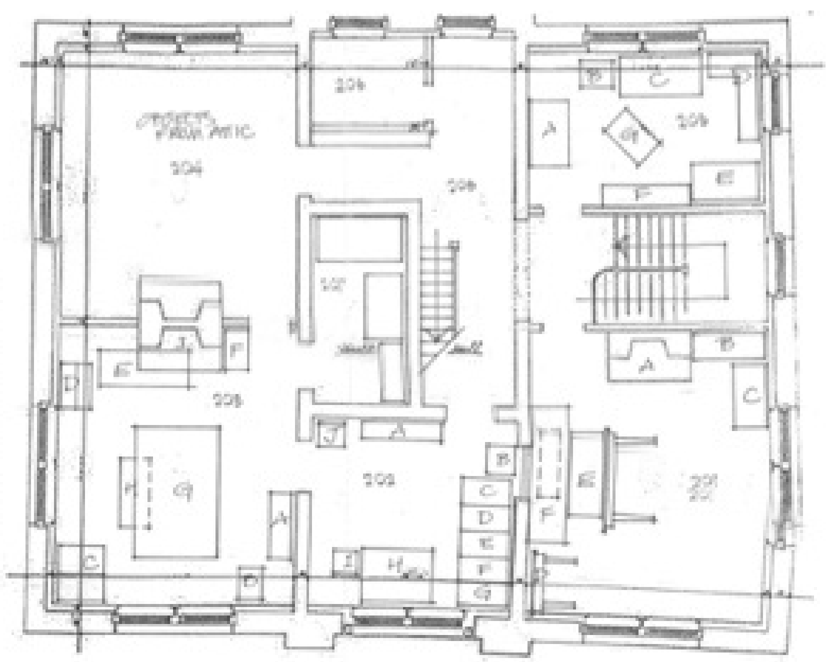


Figure 5.9: Floor plan with large object location and label for inventory. From KNHP Accession KEWE.00033.

During the September 2001 salvage of the contents of the Quincy Mine Office, KNHP created a second story floor plan that accompanied the salvaged objects (Figure 5.9). The rooms were numbered and those numbers were associated with the inventory location. The lettered objects in each room are associated with large furniture items that were in the offices. For example, in room 202, C – G are associated with filing cabinets that were removed. Some of the larger furniture pieces were too large to remove and remain in the building.

The virtual exhibit is comprised of two separate elements – the exterior and the interior (Figure 5.10). The exterior elements will be comprised of elements from the 3D ArcScene documentation, showing changes in the landscape, the office's position in relation to other structures, and the different points on the landscape that are visible from various parts of the office, particularly the general manager's office. The interior exhibit will showcase the material culture of the office, while using photographs, audio, video and the narrative provided in this document to tell the story of the mine office and its function (Figure 5.11, Figure 5.12). The exhibit should represent the office in the first two decades of the twentieth century, one of the most significant times in QMC history.

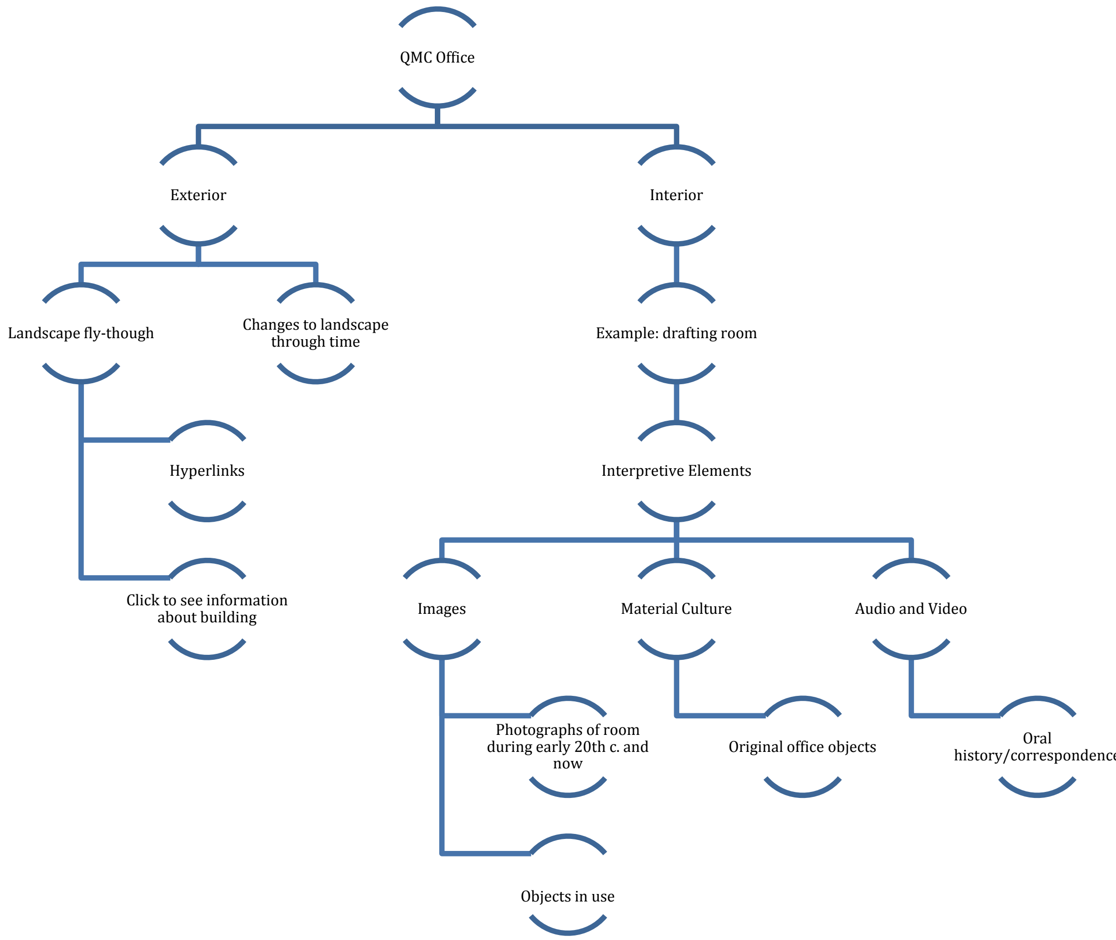


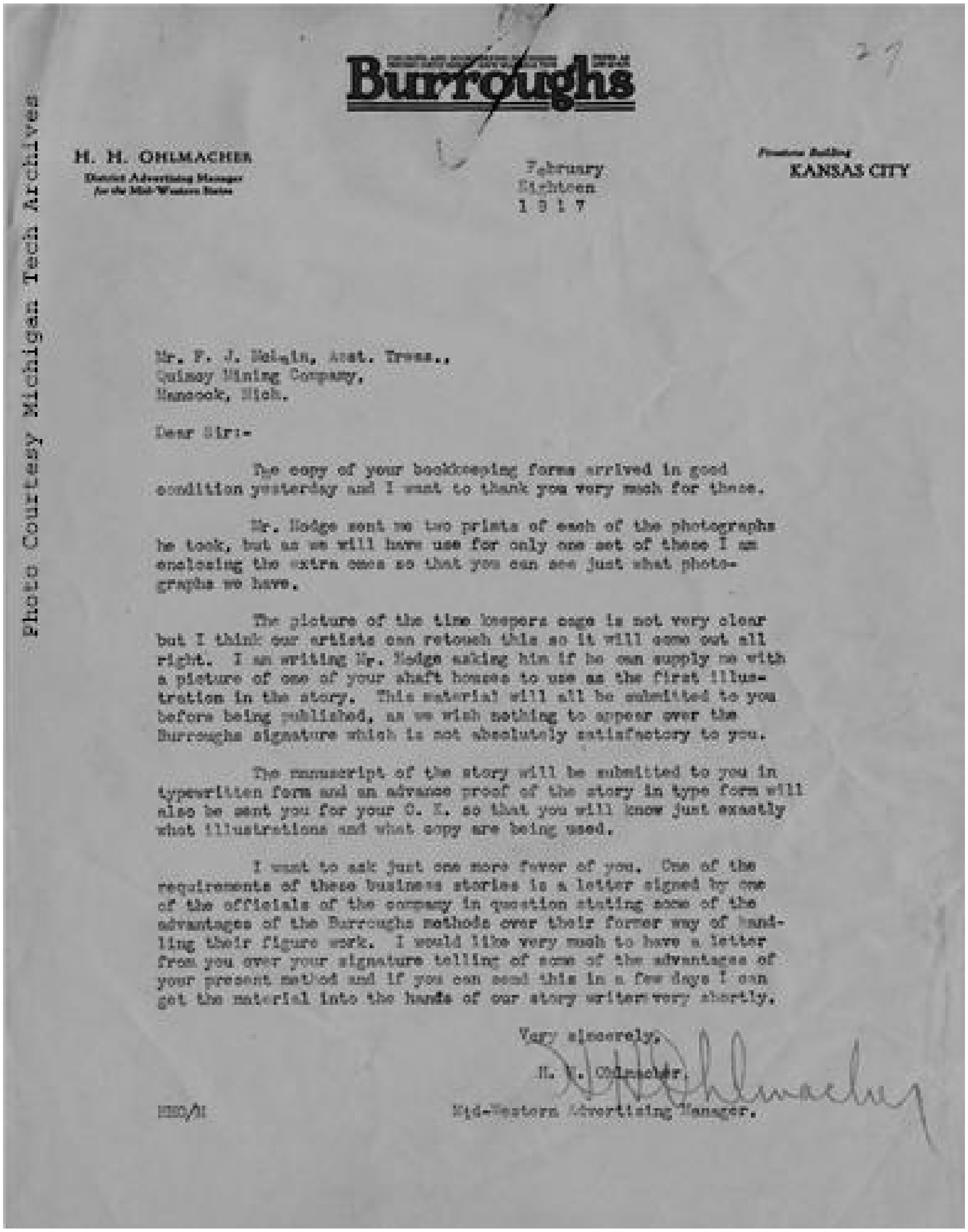
Figure 5.10: Hierarchical chart for organization of the Quincy office virtual exhibit, with examples.

Figure 5.11: Example of QMC office object. This clipboard was made by the user from a plank of wood with the clip attached, later the string was added as extra support to keep papers clipped. Image courtesy of KNHP, 2010.

Figure 5.12: Example of a QMC office object. This is a dead weight steam pressure gauge tester. A pressure gauge would be attached and weights would be added to determine if the pressure gauge was working properly. Image courtesy of KNHP, 2010.

The interior will be comprised of links for the user to click as they navigate through the office, so that, for example, they may see a photograph and description of an object or function that happened in that particular area of the office. Additionally, if the visitor were to click on a file cabinet or desk drawer, they would be able to "open" that drawer, see its contents, and perhaps pull out a letter to read (Figure 5.13). By pulling out a letter, the visitor would be able to see the letter and also have the opportunity to hear it read aloud. The overarching theme will be to provide a personal history, so that the visitor can get a sense of who was working in the office, what they were doing, and how they were doing it.

The Keweenaw National Historical Park has many objects related to the QMC office, of which there are certain representative objects that should be used in a virtual exhibit. QMC office workers often crafted objects to fit their specific needs. This aspect of the office history is also important and could be represented by the objects. In this case, the objects would be clickable, providing the visitor information regarding the object, its construction and its intended purposes. Quincy often made cubby cabinets, drawers and stands to use in their various operations (Figure 5.14). Using and describing these objects in a virtual exhibit will show visitors the human aspects of operations within an office, as workers modified objects to meet their personal needs.



Burroughs

H. H. OHLMACHER

KANSAS CITY

February
Eighteen
1 9 1 7

Mr. F. J. Melgin, Asst. Treas.,
Quincy Mining Company,
Hancock, Mich.

Dear Sir:-

The copy of your bookkeeping forms arrived in good condition yesterday and I want to thank you very much for these.

Mr. Hodge sent me two prints of each of the photographs he took, but as we will have use for only one set of these I am enclosing the extra ones so that you can see just what photographs we have.

The picture of the time keepers cage is not very clear but I think our artists can retouch this so it will come out all right. I am writing Mr. Hodge asking him if he can supply me with a picture of one of your shaft houses to use as the first illustration in the story. This material will all be submitted to you before being published, as we wish nothing to appear over the Burroughs signature which is not absolutely satisfactory to you.

The manuscript of the story will be submitted to you in typewritten form and an advance proof of the story in type form will also be sent you for your O. K. so that you will know just exactly what illustrations and what copy are being used.

I want to ask just one more favor of you. One of the requirements of these business stories is a letter signed by one of the officials of the company in question stating some of the advantages of the Burroughs methods over their former way of handling their figure work. I would like very much to have a letter from you over your signature telling of some of the advantages of your present method and if you can send this in a few days I can get the material into the hands of our story writer very shortly.

Very sincerely,

H. H. Ohlmacher.

HHO/M

Mid-Western Advertising Manager.

Figure 5.13: Letter from Burroughs Company to Quincy, talking about a future publicity booklet. This letter serves as an example of something that can be used in the virtual exhibit to help the viewer understand the complex functions of the office – including publicity. This letter is associated with Figure 5.18. Image courtesy of MTUA/CCHC, image #: MS001.350.010.01, February 1917.

Figure 5.14: This cubby and the twenty-drawer storage unit behind it were both items made by Quincy staff to meet their needs. Evidence of homemade items included the ways in which the objects were constructed and the finish of the wood. For example, on the cubby, one can see inside the cubbies where the maker did not stain the entire piece of wood. Photograph by author, 2010.

Some of the larger furniture pieces, like the blueprinting machine and some large desks, remain in the office and, along with the large desks and drafting tables in the KNHP collection storage could be used as anchor pieces. For example, one of the large drafting tables, a punch, and the Burroughs adding machine, all of which are in the KNHP QMC office collection, are evident in a photograph from the early 20th century (Figure 5.15, Figure 5.16, Figure 5.17). This photograph could be used to not only arrange the room in question, but also to help narrate the story of the office's operations (Figure 5.18). Additionally, the objects in the photograph would then be "clickable" allowing the visitor to interact more with each item. The items would have a description of what it is, what it does, and how it would have been used in the office. The combination of the actual object, the historical photograph of that particular object in use, and the descriptive narrative that accompanies it would allow the virtual exhibit of the QMC office to have complex depth and allow visitors to engage in the material culture, people and history of the building in a more meaningful manner.

Figure 5.15: Image of stamp punch from QMC office. This stamps the Quincy and Torch Lake Railroad name onto documents. Photograph by author, 2010.

Figure 5.16: Drafting table from second floor of QMC office building. Also, one of the two fireplace grates in front of the table are evident in the photograph of the first floor Clerk's office, Figure 4.17. Photograph by author, 2010.

Figure 5.17: Burroughs adding machine on stand with fold out tabletop. Photograph by author, 2010.

Figure 5.18: Image of men and women working on second floor of QMC office. Note the Burroughs adding machine, drafting desk, and stamp punch in the photograph. This photograph would be used to help recreate an authentic experience in the room while also providing valuable insight into the way Quincy operated. Image courtesy of MTUA/CCHC, image #: MS001.350.010.03.

CHAPTER SIX

CONCLUSION

The late nineteenth and early twentieth centuries saw a total shift in management principles and the operation of businesses. The mining industry was not immune to these new ideas, as scientific management principles moved beyond the realm of manufacturing where it began and into other industries. These new ideas of management brought with them not only increased efficiency and cost-saving measures, but the need for a more organized, hierarchical system of management. It was in this need that the mining engineer began to play an important and critical role in mine management operations. At the same time, the increased amount of clerical work that emerged in the late nineteenth century in relation to management changes led to the introduction of women into the managerial workforce. These middle-class women worked as clerks, typists, stenographers, and telephone operators, and in other clerical jobs, as previously broad occupations like bookkeeping began to separate and specialize into certain functions.

Both Calumet and Hecla and Quincy Mining Company implemented changes in management practice during the early twentieth century. Each company, however, implemented ideas of scientific management in varying ways to fit the needs of their individual businesses. C&H, as the largest copper producer in Michigan, modified their mine, surface and office work to adapt more cost-efficient techniques. However, C&H's top concern was not worker pay and work conditions, but instead company profit.

Operations at the Calumet and Hecla Mining Company were very hierarchical under the management of James MacNaughton. As the company expanded, adding more mines and subsidiary companies, a hierarchical form of management seemed best suited for operations. Each mine and subsidiary had a superintendent. Although they were each in charge of their own operations, they ultimately reported to MacNaughton. Additionally, MacNaughton created specialized departments as the company grew. These departments ranged from drafting and accounting, to efficiency and safety. In particular, the efficiency department developed out of the scientific management trends of the early twentieth century.

Quincy Mining Company also implemented changes to create a more cost-effective operation. However, as they were plagued with problems throughout the early twentieth century, their changes were different from those at C&H. Quincy's attempt to streamline mining worked, especially in the office setting. In the mid-1910s, as Quincy was reaching its heyday as a mining company, they looked at themselves as the epitome of good management. This is evidenced by the way in which the company worked with the Burroughs Company to create national advertisements of their inner office workings at the mine. Lawton's management was hierarchical in a sense, but office relations at Quincy were not structured like at C&H. Part of this is due to the office building itself, as the QMC office was much smaller than the C&H office. To accommodate new departments and management changes at Quincy, Lawton had to reorganize his interior space effectively.

As copper prices and the Great Depression delivered a hard blow to the QMC, their cost-saving scientific management measures meant little to help the company stay afloat. During the 1920s, Quincy needed to cut back on cost, much to general manager Charles Lawton's dismay, but managed to cut pay instead of laying off workers, though some workers were still released. In the case of office workers, many of the those let go were female clerks, most likely because it was assumed their time employed would be short, as women often left places of employment when they were to be married. In both C&H and QMC, the general manager of the mine directly affected new management ideas and their implementation at the mine.

Both MacNaughton and Lawton operated their companies in different manners, as is evidenced by their varying interpretations of the new management ideas that came from scientific management. While both men implemented efficiency engineers and efficiency departments, more evidence points to the implementation of time and motion studies of people and machinery at C&H. Though Quincy had an efficiency department, their efficiency work was not as highly detailed as the work at C&H. This is due to the different personalities of the general managers, the realities of mining for both companies, and the sheer size of C&H as compared to QMC. As C&H grew, so did their need for a more efficient system of management that would allow them to make the most profit possible.

The relationship of each general manager to his workers also affected the management of both companies. As Carlton (1912) noted, Taylor wrote regarding the importance of the relationship between the worker and the manager. In this case, C&H and Quincy were on very different planes of existence. MacNaughton was not a friend to the workforce, though he did treat his office workers, in particular the female workers, with respect. This relationship meant that the office was a pleasant working environment, but the workforce outside the office did not see it as such and viewed MacNaughton as a man only concerned with the well being of the company, not of the workforce. On the other hand, Lawton attempted to advocate on behalf of his workforce, both in the office and outside the office, when mining began to decline for Quincy. This is most evident in his correspondence to the company President and other officials, in which he wished to cut costs, but not by laying off the workforce. Lawton tried to strike a balance between the company's well being and the workers' well being, a trait that was key to scientific management.

Mining became a highly scientific process under both general managers, but more so at C&H. Also, each company implemented scientific management practices into their management strategies and office environments. At C&H, efficiency engineers created guidelines for work, instructions for workers, and, at times, bulletins detailing new procedures. Additionally, C&H expanded operations to include new, specialized departments that would handle specific tasks like employment. Quincy's management strategy was different than that at C&H. Though Quincy incorporated new specialized departments, their limitations came from the lack of space for such operations in their office and the firm commands from management on the east coast regarding changes. While MacNaughton was able to work freely and with minimal consultation of the corporate management, Lawton had to contend with a strong management contingent in New York that ultimately decided what Lawton could or could not do at the mine. So, while Quincy was able to establish new departments, like employment, their adoption of scientific management procedures was not as detailed as C&H's adoption.

Currently, both offices still stand and have taken on different meanings. The C&H office has become the headquarters for the Keweenaw National Historical Park, which also owns the QMC office. The QMC office serves as rented space for local community organizations, though eventually the KNHP will interpret at least a partial section of the building. To this end, a virtual exhibit will be very beneficial to recreate the history of the QMC office and its operations.

Virtual exhibits help museums and other historical institutions move beyond abstract interpretations, where visitors can walk into spaces and see objects and rooms, without necessarily having the opportunity to interact with them. In the case of a virtual exhibit, the visitor has the ability to navigate through a space, clicking upon various aspects of it to create a meaningful and customized experience. This experience can include multiple elements at once. For example, a clickable link in a virtual exhibit can show the visitor an object, a description of that object, a video of that object in use, and a photograph of that object in its historical provenance. Combining all of these elements into one creates an experience that is hard to recreate in the physical space of an exhibit.

This technique can then be applied to the QMC office. One of the most interesting and important aspects of a QMC office exhibit is the proliferation of material culture and archival information that still exists, with known provenience in most cases, from the office. Much of this material dates to the early twentieth century, which also represents some of the most important years in the history of the QMC. Also, using software, like ArcGIS, allows for the interpretation of the QMC office exterior landscape. Recreating the exterior landscape, including structures that are no longer present on the landscape, allows visitors to then also see the importance of the office's location on the mining landscape.

However, the QMC is a structure in which the KNHP may not be able to physically interpret for many years and, when they finally can, may not be able to interpret fully. Necessary changes to the structure, including ADA compliance, and the needs of the rental organizations will keep parts of the office off-limits to visitors. A virtual exhibit will then have the ability to expand upon the physical exhibit, allowing visitors access to areas, objects, things, and people's experiences that they would not normally be able to have.

Overall, early twentieth century management changes infiltrated the management of the Copper Country. These ideas were then modified and changed to fit the needs of the individual companies. Both C&H and QMC were important producers of copper from the area and each general manager operated his respective company in very distinct manners, representing his own personality and experiences, plus the views of corporate management on the east coast and the realities on the ground at the mines and surface plants.

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APPENDIX A

GEOREFERENCING QUINCY HILL SANBORN MAPS, 1900-1928

Introduction

The process of georeferencing Sanborn Fire Insurance Maps for historical research can provide valuable insight into the change in time over an historic industrial landscape. Archaeologists have realized the benefit of using GIS to note change in landscape over time because, as land use changes over time, features burn down or are demolished, leaving no visible remnants in an empty lot or are buried beneath newer structures (Kolodziej, et al. 2004:5). Using ArcGIS software, specifically ArcMap, to map changes allows the industrial archaeologist to note changes in the landscape that would not necessarily be evident from looking at the maps alone. Though fire insurance maps show a detailed view of an industrial site, they are not always 100 percent accurate. In the case of the Quincy Hill fire insurance maps, the remains of some features still remain on the current landscape; however, when attempting to choose ground control points, it quickly becomes evident that the Sanborn maps are not easily matched to the landscape. This project focuses on the Quincy Mining Company office building and the changes in the surround landscape using four Sanborn maps from 1900 through 1928.

Sanborn Fire Insurance Maps

Many industrial archaeological projects look to Sanborn Fire Insurance Maps for insight into industrial site layouts. Established in 1866 by Daniel A. Sanborn, the National Insurance Diagram Bureau, Sanborn's company quickly became the largest, and best-known, name in insurance mapping. In format, Sanborn maps included an index map with key symbols to help the user find the area in question. These maps were incredibly detailed, noting aspects such as construction type (in color), roof materials, number of stories, and what type of occupancy. Surveyors noted all of the details in the field, and then these detailed notes were sent to a publishing officer, where draftsmen transferred the information to lithographic stones. Employees, usually female, then traced the color-coding for structures by hand. The final step involved binding the maps together into a book (Wright 1983:2).

Fire insurance maps have proved invaluable to historic research in industrial archaeology. In general, insurance mapping in the United States began in the mid-19th century. Within the first few decades of the 19th century, many cities were destroyed by fire, including the small, local insurance firms located in those cities. As industrialization spread, large urban centers were created and with those, large insurance companies. These companies' offices were not always located near the locations of their clients, thus creating the need for detailed maps of properties (Wright 1983:1).

Part of the Sanborn process involved correction over time. Sanborn maps were not recreated on a set basis, but happened roughly once a decade. Often, the surveyors would take the existing, earlier map and paste changes over it, in order to avoid drawing an entirely new map. This can cause some difficulties in mapping change over time, however, as the previous site formations have been covered over (Wright 1983:2). Additionally, though Sanborn maps were incredibly detailed and provided correction services, they were not always 100 percent accurate. This provides an issue when attempting to georeference them to current maps.

Quincy Hill Sanborn Maps Rectification

The four subject Sanborn maps included the years 1900, 1907, 1917 and 1928. These maps show the Quincy Mining Company property on Quincy Hill in Hancock, Michigan. The Quincy Mining Company office was originally located in a structure that sat on the adjacent lot south of the sandstone office that currently stands. The current office was constructed in 1896 of local Jacobsville sandstone. Built at the height of the Quincy Mining Company's success, this office represented the wealth and status of the mining company (Eckert 1993:471). The four corners of this office provided the first four ground control points used on each of the Sanborn maps.

An 1893 Sanborn map for Quincy Hill also exists. As many changes occurred on the landscape between this map's construction and the 1900 map, I attempted to georeference the 1893 map as well. Using the Digital Ortho Quarter Quad (DOQQ) for Houghton county, reprojected to NAD83 UTM Zone 16N, I began to look for structures that may match features on the Sanborn map for 1893. Some issues occurred from the start though, in that many of the buildings on that map do not exist on the current landscape. The structures, though they appear to match with currently standing structures or remains, continually did not allow for appropriate transformations. I attempted to try the first, second and third order, but the image was consecutively distorted.

A feature of the Quincy Hill Sanborn maps is the structure of the map drawing itself. In the case of all four maps, the map consisted of two sections on one sheet, separated by a "no exposure" line. This created confusion on my part at first; however, I soon realized the issue and proceeded to remedy the problem. Starting with the 1900 Sanborn map, I chose ground control points on the Sanborn that matched with existing structures on the DOQQ for Hancock. By using the office building as a reference point, it became relatively easy to find which other structures on the current landscape that still existed. In addition to that, it also because evident which other features no longer existed and what was currently in their place. The same held true for the 1907 map.

Georeferencing the 1917 map came with different issues. Not only did the "no exposure" line still exist down the center of the map, but there were two other buildings drawn on the map that were not in the correct locations. One of these buildings no longer existed on the current landscape. Because of this, my only option was to remove it from the map. After I chose the GCPs for that section of the map, I used the "extract by mask" feature to cut out the rectified section only. The other building was still on the landscape, and I recognized it from previous knowledge of the Quincy Mining Company industrial site. In this case, I also used the "extract by mask" feature to create a new layer for that building, and then proceeded to georeference that building as well.

The 1928 Sanborn map rectification was similar to that of the 1917 Sanborn map. However, while the 1928 map was also split into two sections, it covered a larger area to the north than the previous three maps. This map required me to extract five different sections in order to line up the sections. The first problem came from an error on the map, in that the draftsmen did not put a "no exposure" line around a cluster of buildings that did not belong in that location on the map. After attempting to choose ground control points for those buildings and realizing that those buildings were causing the issue, I used the "extract by mask" feature to create a new layer with those buildings, effectively solving the problem. Looking closely at the map, it appeared that, instead of placing a "no exposure" line around the buildings, the draftsmen instead wrote that the cable attaching shaft-rock house number 2 and the hoist house was 300 feet long, which did not fit into the scale of the map.

The northernmost extent of the maps for 1900, 1907 and 1917 is a supply house located to the north of shaft-rock house number 2. However, on the 1928 Sanborn, the northernmost extent is located further north, beyond the location of shaft number 6. After splitting this map into two sections, and attempting to rectify the northern half of the map, it quickly became apparent that, again, this map would need to be split in order to better match up the current landscape with the historic. This time, I split the map down the north-south running “road to Calumet,” which is currently US-41. The eastern half of this map lined up nearly perfectly with the current landscape. The western half, however, did not. After attempting to choose ground control points that worked, and continuously having a high RMS error, usually around 8 or 9, it became apparent that the surveyor’s measurements may have been incorrect, or the draftsmen interpreted them incorrectly.

Beyond choosing ground control points for georeferencing, the Sanborn maps required other processes. In order to split the maps into their different sections, cookie cutters were created. For each map, I created a polygon shapefile in ArcCatalog. I then added the shapefile to the ArcMap document and proceeded to create the polygon that would be used in the “extract by mask” process. This often required multiple cookie cutters for each map, as some had multiple “no exposure” lines, like the 1928 map, for example. Once the maps were split and rectified, the sections of the map needed to be mosaicked together. Using the Mosaic Pro process in ERDAS Imagine, the various rectified sections of the map were mosaicked into one file and then added back to ArcMap to create the finished map. This final process showed not only the change over time on the landscape, but also the errors that occur between the hand measured and drawn, paper Sanborn maps and the DOQQ of Quincy Hill.

Issues in Georeferencing Quincy Hill Sanborn Maps

Extending beyond the issues with lining up features on the Sanborn maps to features on the Hancock map, other inconsistencies appeared after rectification and mosaicking of the map layers. One of the main inconsistencies occurred in relation to the alignment of the main "road to Calumet." This road stayed mostly in line with the current alignment of US-41, with the exception of the curvature in front of the Quincy Mining Office where the old road is still visible in front of the office. However, when the map sections were mosaicked together, the road often did not line up perfectly on both maps. Where the origin of the problem lies is unknown; however, it is most likely a combination of error in the Sanborn map scaling and the RMS error in the rectified maps.

A similar issue occurred when mosaicking the map sections together in that some buildings would not line up perfectly. The edges of both sections of the map often showed slight overlap, so as to not miss any sections of the buildings. However, when the sections were split and rectified, the overlap often did not match. One such instance occurred on the 1900, 1907 and 1917 maps, in that a long storage building was shown but, when ground control points were chosen for this building on both maps, the end result was not in line. On the 1928 map, the storage building to the north of shaft-rock house number 2 was shown on both sections as well, but once rectified, the top section of the map was not in alignment.

Conclusion

Errors in the Sanborn map occur both from the map measurements themselves and from attempting to transfer information from a flat sheet of paper to a real-world map. In order to correct for such errors, steps such as splitting maps into various sections in order to get the best rectification can be taken. Additionally, to correct for larger errors in rectified maps, it is possible to digitize lines to correct buildings in raster files or convert the raster file to a vector file and use the rubber sheeting process to manipulate the data to more closely match the map. The goal of this project was to georeference the Sanborn maps for Quincy Hill and see how closely the historical data matched the real-world configuration of features on the current landscape.

In the end, each of the rectified Sanborn maps successfully fulfilled their purpose by showing the analyst changes in the landscape that are not necessarily visible by looking at the maps on their own or by visiting the site and conducting a walking survey. Further analysis of the data from each map, through combining the rectified maps and comparing the data, can share new information regarding the use of the Quincy Mining Company landscape on Quincy Hill and the current state of that landscape. Additionally, the rectified Sanborn maps can help researchers to locate on the landscape areas of interest for further archaeological excavation or to locate areas of potential environmental danger, such as industrial waste sites. Using ArcGIS software to manipulate data from Sanborn maps gives industrial archaeologists an analysis tool that allows for different interpretations of data than using the Sanborn maps as they exist in paper format.

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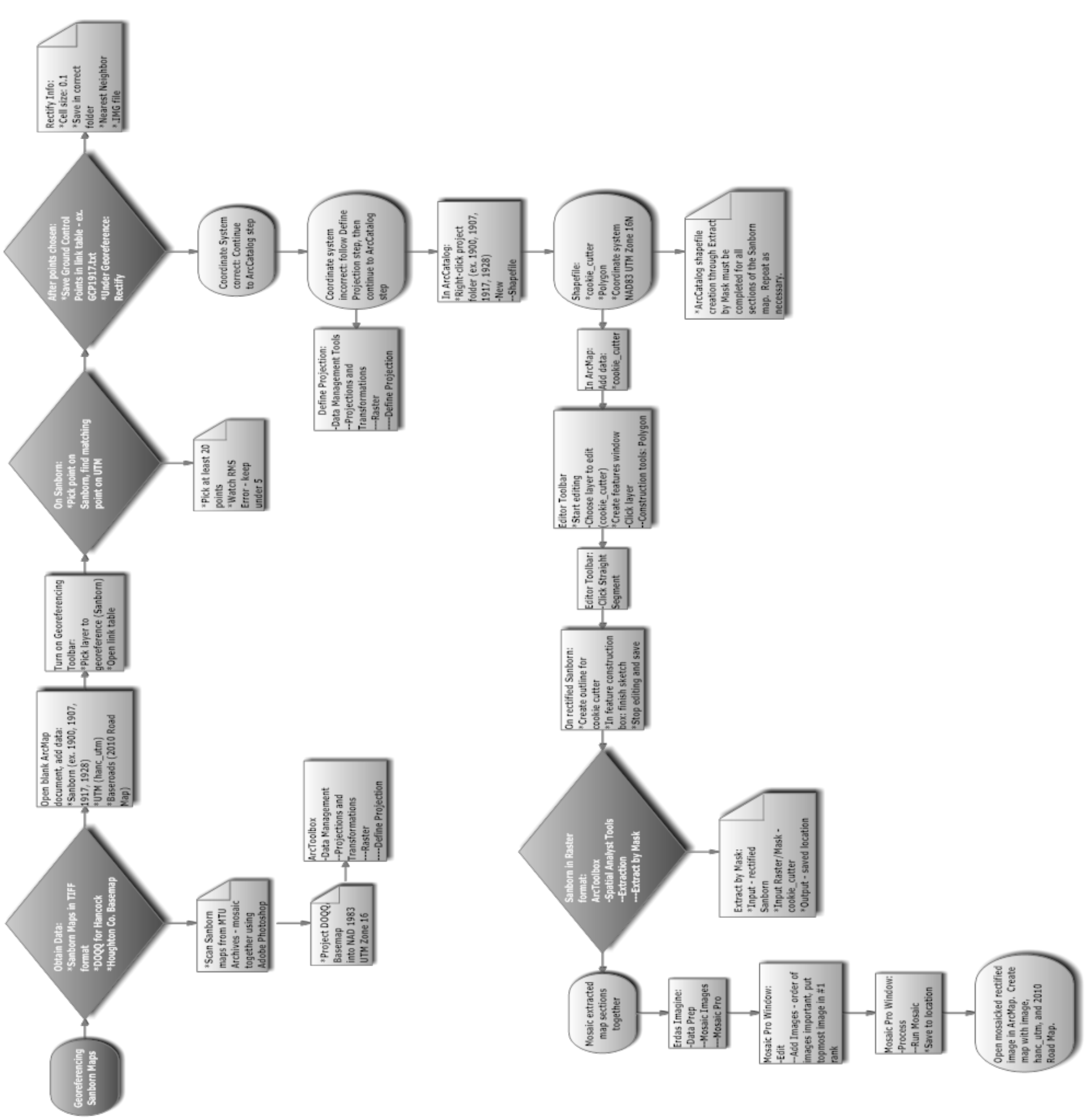
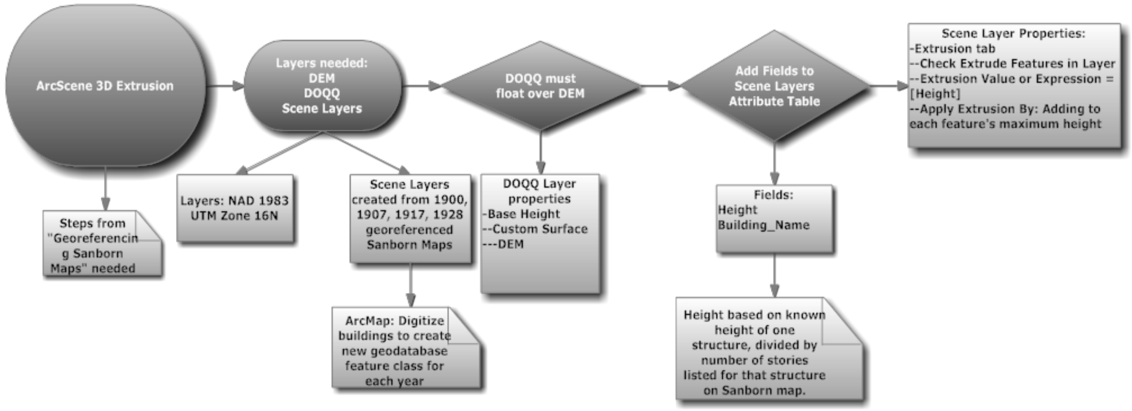
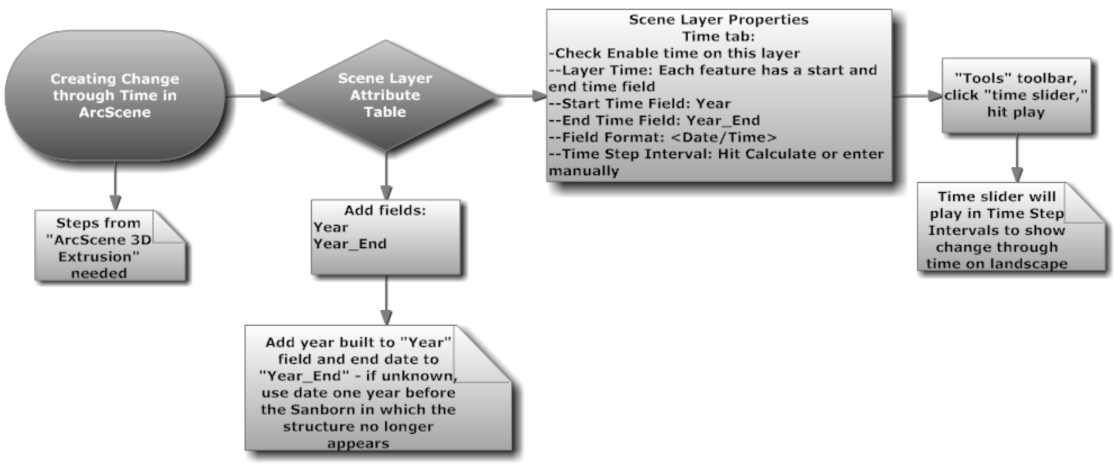
1983 Insurance Mapping and Industrial Archeology. IA: The Journal for the Society of Industrial Archaeology 9(1):1-18.

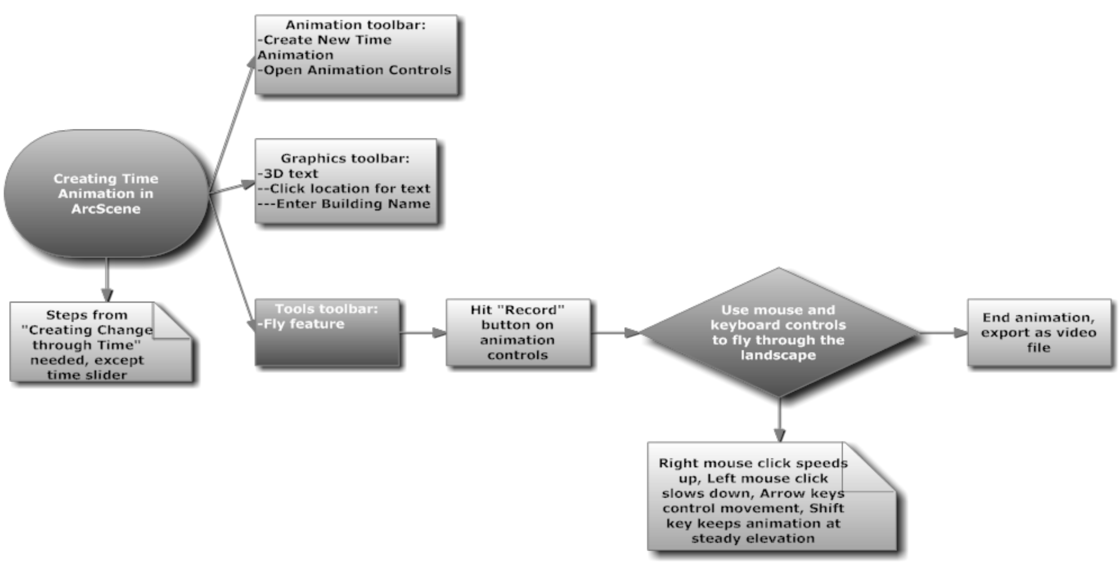
APPENDIX B

ArcGIS FLOWCHARTS




ArcScene 3D Extrusion
Layers needed:
DEM
DOQQ
Scene Layers
DOQQ must float over DEM
Add Fields to Scene Layers Attribute Table
Scene Layer Properties:
-Extrusion tab
--Check Extrude Features in Layer
--Extrusion Value or Expression = [Height]
--Apply Extrusion By: Adding to each feature's maximum height
Steps from "Georeferencing Sanborn Maps" needed
Layers: NAD 1983 UTM Zone 16N
Scene Layers created from 1900, 1907, 1917, 1928 georeferenced Sanborn Maps
DOQQ Layer properties
-Base Height
--Custom Surface
---DEM
Fields:
Height
Building_Name
ArcMap: Digitize buildings to create new geodatabase feature class for each year
Height based on known height of one structure, divided by number of stories listed for that structure on Sanborn map.


Creating Change through Time in ArcScene
Scene Layer Attribute Table
Scene Layer Properties
Time tab:
-Check Enable time on this layer
--Layer Time: Each feature has a start and end time field
--Start Time Field: Year
--End Time Field: Year_End
--Field Format: <Date/Time>
--Time Step Interval: Hit Calculate or enter manually
"Tools" toolbar, click "time slider," hit play
Steps from "ArcScene 3D Extrusion" needed
Add fields:
Year
Year_End
Time slider will play in Time Step Intervals to show change through time on landscape
Add year built to "Year" field and end date to "Year_End" - if unknown, use date one year before the Sanborn in which the structure no longer appears


Animation toolbar:
-Create New Time Animation
-Open Animation Controls
Graphics toolbar:
-3D text
--Click location for text
---Enter Building Name
Creating Time Animation in ArcScene
Steps from "Creating Change through Time" needed, except time slider
Tools toolbar:
-Fly feature
Hit "Record" button on animation controls
Use mouse and keyboard controls to fly through the landscape
End animation, export as video file
Right mouse click speeds up, Left mouse click slows down, Arrow keys control movement, Shift key keeps animation at steady elevation

APPENDIX C

IRB AND PHOTOGRAPHIC REPRODUCTION APPROVAL

Protocol #: M0637

Protocol Title: "Preserving and Interpreting the Mining Company Office: Landscape, Space and Technological Change in the Management of the Copper Industry"

Approved Dates: August 24, 2010 through August 23, 2011

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