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MICHIGAN IRON ORE MINING SAFETY:
POLICIES AND FATALITIES, 1880-1979

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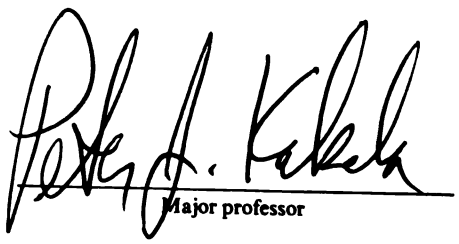

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MICHIGAN IRON ORE MINING SAFETY; POLICIES AND FATALITIES, 1880-1979

By

Anne Elizabeth Wilson

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ABSTRACT

MICHIGAN IRON ORE MINING SAFETY; POLICIES AND FATALITIES, 1880-1979

By

Anne Elizabeth Wilson

The mining of Michigan iron ore was one of the industries essential to the transformation of America from an agricultural to an industrial nation. The iron ore mines of Michigan's Marquette Iron Range were uniquely important during the early period of industrialization because they provided an ore with the proper composition to produce the strongest steel possible at the time. Although greatly enhancing America's growing industrial prowess, this ore was produced at a very high social cost—the lives of hundreds of mine workers.

The underground era of mining, from 1880 to 1979, on the Marquette Iron Range claimed 957 lives. And in the late 19th and early 20th centuries the fatality rate (deaths per 1,000 employed) in the mines was one of the highest in the industrialized world. After 1920, however, the underground fatality rate dropped suddenly, finally approaching that which industrialized European countries had achieved by the mid-1800s.

To assess the social cost of underground mining on the Marquette Range, the causes of fatal mining injuries were first determined. The factors that decreased the fatality rate were then examined. A steady decline in fatality rate is attributable to the gradual improvement in mining skill and ability to speak English of the largely

immigrant workforce, advances in technology, and changes in the contract mining system and mining methods.

However, the sudden drop in fatality rate seen in the 1920s results from managerial response to stimuli for change that developed outside of the mining district itself: Management felt the necessity to combat strikes and unionism, anti-trust legislation, changes in the employer's liability system and the introduction of Workmen's Compensation legislation, and intense public scrutiny promoted by popular journalism. These movements and policies forced employers to improve working conditions by promoting safety and thus decreasing the number of fatal accidents. To be successful, the methods used to achieve these goals had to be promoted by owners and managers and were the essence of what was called the Safety First Movement. The decreased death rate seen in the data and the increasingly frequent references to the Safety Movement and its role in reducing the fatality rate found in the Lake Superior Mining Institute Proceedings are evidence of its introduction and success on the Marquette Iron Range.

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CHAPTER 1

INTRODUCTION

Background of the Research

This study attempts to estimate a portion of the social cost associated with industrial progress in the United States. A significant portion of this social cost can be attributed to the mining industry. Mining was the basic industry that provided the metal ores and fuels necessary for the technological progress and rapid industrialization which occurred in America in the late 19th and early 20th centuries. And in mining, America led the way in workplace deaths.

Located in the Upper Peninsula of Michigan, were valuable deposits of iron ore: The mining of these ores claimed the lives of hundreds of mine workers. In the 100 years of ore production on the Marquette Iron Range studied here, 957 underground mine workers died providing a total of 309,423,209 tons of ore.[1] This gives an average production of 323,326 tons/fatality. Before 1920, when a remarkable decrease in fatality rate is seen, 818 fatalities occurred in the production of 109,921,399 tons of ore, an average rate of 134,387 tons per fatality. After 1920, 199,501,810 tons of ore were produced with 139 fatal accidents, an average of 1,435,265 tons per fatality.

Although there were three locations in Michigan where iron ore was mined (termed Iron Ranges) this research was limited to the Marquette Iron Range for two

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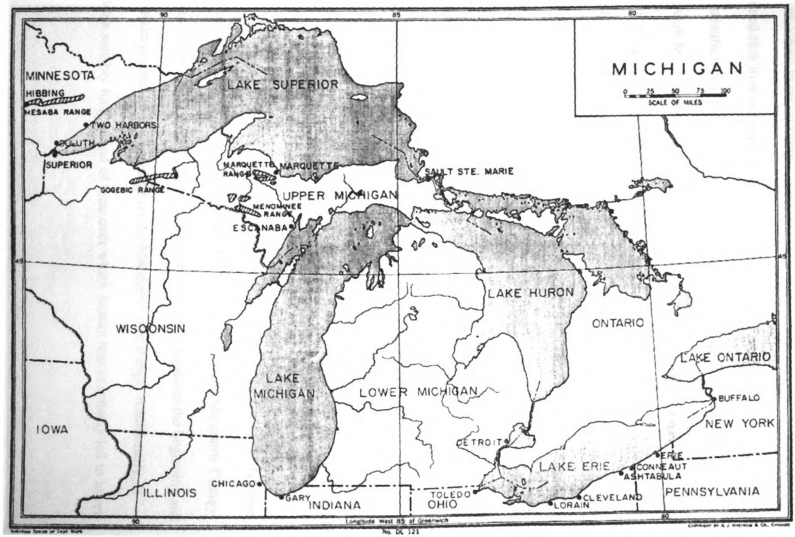
[1]The production and shipment of iron ore is measured in long tons (lt) = 2,240 lbs. However, historically, the sources of data refer to the amounts of ore produced and shipped simply as tons. This convention will be followed in reporting production and shipment data for this research. The data should, however, be considered to represent long tons.

Figure 1. Regional Map of the Lake Superior Iron Ore District and Selected Ports.



reasons (See Figure 1): First, the Marquette Range was the first to be discovered and thus the leader in establishing mining methods, technology, and philosophy. Second, it contained rich iron ore deposits that were uniquely compatible with the most advanced steel manufacturing technology of the time, the Bessemer process. These iron ores, along with Michigan copper, provided the basic material that enabled America to rise from an essentially agricultural nation to the greatest industrial power in the world. In fact, Michigan iron ore was perhaps the greatest single factor involved in shaping the industrial advancement of the developing nation. The important connection between Michigan iron ore and the ascendancy of industrial power in the United States provides an excellent background against which the social cost of a vital natural resource can be examined.

Since Michigan iron ore was necessary for industrialization and death represents clear, solid data of the ultimate social cost it was decided that a case study of mine fatalities that occurred in this uniquely important mining region would provide an initial step toward documenting the social cost of American industrialization.

This research consists of an examination of factors that contributed to fatalities among underground iron ore miners on the Marquette Iron Range, Marquette County, Michigan, from 1880 to 1979. The time period chosen encompasses the beginning and end of underground iron ore mining on the Marquette Iron Range. Additionally, it provides a suitably long period of time over which factors that eventually led to lower

fatality rates could develop.[2] Identification and assessment of the importance of factors leading to both high and low fatality rates is central to this research.

The Social Cost of American Industrialization

In the late 19th and early 20th centuries, as America moved to become the leading industrial producer in the world, the American workplace came to be recognized as the most dangerous in the world. Historians share in the strong consensus that the late 19th and early 29th centuries marked a low point in terms of industrial safety in the United States as growing businesses put profit ahead of people. From 1860 to 1929 between 25,000 and 35,000 workers may have died annually in industrial accidents and more than 1 million may have been injured (Lankton and Martin, 1987).

Clearly, although producing numerous social benefits, the enormous wealth produced by the new industrialization was achieved at a great social cost in the most fundamental sense—loss of human life and limb. As noted by an anonymous observer in 1907:

> To unprecedented prosperity...there is a seamy side of which little is said. Thousands of wage earners...are caught in the machinery of the record breaking production and turned out cripples. Other thousands are killed outright. How many there are none can say exactly because we are too busy making our record breaking production to count the dead (Rosner and Markowitz, 1985, p. 508).

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[2]One factor contributing to a decline in death rate over time in any industry may be attributed to improvements in the treatment of trauma. E. A. Vastyan in "Civilian War Casualties and Medical Care In South Vietnam," has pointed out that "Among U.S. Combat casualties who reach medical aid, the death rate has fallen from 4.8% in World War I and 2.5% in the Korean War to but 1.0% in Vietnam." This factor was eliminated from the fatality data in this study by using cases of instant death (p. 611-624).

The magnitude of the problem can be appreciated when it is realized that between 1900 and 1982 over 103,000 workers died in American coal mines. The most disastrous year was 1907 in which 3,242 miners were killed (Wallace, 1987, p. 338). Coal mining fatalities routinely exceeded 2,000 per year until 1930 and it was not until after 1980 that this number dropped consistently below 100 per year (Marovelli and Karhnak, 1982, p. 90, 102). In fact it was not until 1991, for the first time in more than 200 years, that the underground coal mines in Pennsylvania went an entire year without a single fatality (*Skillings Mining Review*, 1992, p. 6).

The Social Cost of Iron Ore Mining

Worldwide, American metal ore mining fatalities were unsurpassed. During the first few years of the 20th century, England, Germany, and France experienced mining death rates of fewer than 1.5 fatalities per 1,000 employees per year, while in the United States the rate was more than 3 fatalities per 1,000 employees per year (Reeve, 1907).

In the late 19th and early 20th centuries, the mining fatality rate in the mines of the Marquette Iron Range was even higher than the American or European average. Studying a six-year period from 1888 to 1894, Lake Superior Mining Institute (LSMI) President J. Park Channing found the death rate for men employed underground on all three of the Michigan iron ranges to be 5.670/1,000. For the Marquette Iron Range, for the same period, Channing found that the average death rate was 4.768/1,000. These results, when compared to those elsewhere, Channing told the LSMI in 1895, "are not to be commended" (p. 39).

Fatality data for selected European mining districts was provided by Channing and are shown in Table 1.

Table 1. Fatality Data for Selected European Metal Ore Mining Districts.

Date	District	Avg. Fatality Rate
1867-1890	metalliferous mines of Prussia	1.36/1,000
1881-1890	same as above	1.254/1,000
1891	same as above	1.035/1,000
1892	same as above	1.081/1,000
1891-1892	hematite district of Great Britain	1.7/1,000 (surface and underground
1873-1881	Cornwall-Devon	2.63/1,000 (underground)
	all mines under the Metalliferous Mines Act in Great Britain	
1873-1882		2.346/1,000
1883-1892		2.145/1,000

Note: From "Address by the President," by J. Park Channing, 1895, *Proceedings of the Lake Superior Mining Institute [LSMI], III,* pp. 34-39.

Data collected for this research is presented in Table 2 and shows that the average fatality rates on the Marquette Range were much higher than the European averages compiled by Channing. They remained close to the six-year average rate for the Range until 1920. The average fatality rate cannot be determined for the full decade 1879 and 1889 because of limited employment data.

Table 2. Average Death Rate per Decade On the Marquette Iron Range Per 1,000 Workers.	
.....1889	4. 14
1890 -1899	4.96
1900 - 1901	5.47
1910 - 1919	4.21
1920 - 1929	1.71
1930 - 1939	1.55
1940 - 1949	2.21
1950 - 1959	1.07
1960 - 1969	0.81
1970 - 1979	0.31

The number of fatalities and the fatality rate on the Marquette Iron Range dropped remarkably beginning in 1920. From then on, the death rates were maintained at a level close to those which European countries had achieved in the late 1800s. Explanation of the rapid decrease in death rate seen beginning in 1920 is an objective of this research. The hypothesis is that the key factor to reducing iron ore mine fatalities on the Marquette Range was the assumption of responsibility of worker safety by management.

Comparison of Related Industries

Iron ore mining was not the only dangerous industry in rapidly growing industrial America. Manufacturing of all types took their toll on workers' lives but

notably dangerous were railroading and coal mining. The fatality rates for underground workers on the Marquette Iron Range are less than those for trainmen but comparable to those for bituminous and anthracite coal miners, an industry that has been proclaimed the most deadly in the United States and whose death rate stimulated the organization of the U.S. Bureau of Mines as well as the earliest state mine safety laws. (See Table 3.)

Table 3. Average Fatality Rates per Decade in Michigan Copper Mines, Marquette Iron Range Mines, U.S. Bituminous and Anthracite Coal Mines, and for Trainmen; 1870-1930.

	Cu	Mqt. Range	Coal		Trainmen
			Bit.	Anth.	
1870-1897	3.2	-	-	-	-
1880-1889	6.0	4.14 (1889)	-	-	8.52 (1889)
1890-1899	4.0	4.96	3.81	5.22	7.72
1900-1909	3.3	5.47	5.09	5.36	7.61
1910-1919	4.7	4.21	4.51	4.31	4.36
1920-1929	3.8	1.71	4.71	3.89	2.23
1930-1939	-	1.55	3.93	3.88	1.31

Note: Column 1 (Michigan Copper Mines) from Technological Advance, Organizational Structure, and Underground Fatalities in the Upper Michigan Copper Mines, 1860-1929, by Larry D. Lankton and Jack K. Martin, 1987, in *The Society for the History of Technology*, p. 57. Columns 3, 4 and 5 (Coal and Trainmen) from *Safety First* by Mark Aldrich, (1997) pp. 291-293, 300-301, Baltimore, MD: The Johns Hopkins University Press.

It can be seen that the social cost, as represented by fatalities, extracted by several basic American industries was very high. With respect to the Marquette Iron

Range mines, the social benefit (ore produced) increased greatly over social cost (loss of life) after 1920. Nevertheless, for each man that died that cost was of infinite value.

Objectives of the Research

The goal of this research is to find and present data that satisfies four major interrelated objectives. It is hoped that as the objectives are met a clearer idea of the social cost of mining a resource vital to the industrialization of the country will be developed. A small part of the total social cost of industrial advancement will then be known.

The first objective is to collect, insofar as possible, a complete record of deaths that occurred in the underground iron mines of the Marquette Range from 1879 to 1979 and from these establish a comparable set of data, i.e., death rates. This objective is factual rather than interpretive.

The second, and more interpretive objective, is to define the causes of the fatal accidents and determine the factors involved in lowering the fatal accident rate. This objective is more complex than the first and its explanation requires some basic historical understanding of the mining industry, the material mined, and the region in which the accidents occurred. Additionally, a brief understanding of the national legal, political, and economic conditions existing at the time and their relationship to the mining industry is necessary.

It also becomes important to define the personal characteristics of the men involved in the hazardous business of mining, both owners and miners, and assess the importance of these characteristics with regard to increasing or decreasing the number of fatal accidents that occurred. It must be realized that in the mining of iron ores no

one could "get rich quick" as they could by mining precious metals, like gold. Additionally, the monetary benefits usually did not accrue to those who bore the greatest risk of the mining ventures, the miners.

Imbedded in the second objective is a third and major objective. That is to explain the dramatic and permanent decrease in the death rate that occurred after 1920. Data is presented that supports the hypothesis that the major factor in the sudden decrease in fatality rate after 1920 was related to what has come to be called the "Safety Movement." This movement was not an isolated effort at the hands of a few humanitarian mine owners in an isolated mining district, but was part of a broad based movement that was highly multifaceted, having both a humanitarian and economic side. Unfortunately, without forces at work which put the profits of "big business" at stake, the decrease in fatal accidents in the Marquette Range iron mines (and elsewhere) would have been much slower in coming. Stimulating the Safety Movement was an economic rationale that would result in long-term financial benefits for the mining companies and reduce the conflict between labor and management. Although we would like to believe it was based solely on human values, the economic side is evident. This objective is interpretive and must also be supported by historical background.

The fourth and final objective is to add to the empirical basis of the evolution of worker safety in an area where anecdotal accounts abound. While many authors have studied workplace fatalities in many industries, including mining, and hundreds of anecdotal accounts of gruesome workplace deaths are to be found, nowhere is there a complete study of fatal underground mining accidents on the Marquette Iron Range, their causes and remedies.

Significance of the Research

The Marquette Iron Range fatalities are historic. However, a retrospective assessment of the causes of fatalities in the underground mines of the Marquette Iron Range may provide valuable information with regard to worker safety in developing countries where, still today, hundreds of miners' lives are often lost. Other industries in these countries take a significant human toll as well.

The significance of workplace deaths in the overall context of what is called "progress" was addressed by Crystal Eastman in her 1906-1907 study of work-related fatalities in Allegheny County, Pennsylvania. Referring to the workplace deaths documented in her study she asked,

> Is this loss a waste? This is a question which Pittsburgh and every other industrial district must answer. If it is merely an inevitable loss in the course of industry, then it is something to grieve over and forget. If it is largely, or half, or partly unnecessary, a waste of youth, skill, and strength, then it is something to fight about and not forget (Eastman, 1910, p. 15).

If it could be found that the iron range fatalities were even partly unnecessary then an analysis of their causes and remedies has important implications for the improvement of conditions that lead to workplace deaths in mining and other industries in developing countries. In these countries especially, the loss of lives of productive citizens provides a major setback to already marginal economies and families. The same analysis also provides a reminder for modern, highly industrialized countries of what can happen when the value of human life is put second to profit.

CHAPTER 2

METHODOLOGY

This research is a step toward estimating the social cost of industrialization in the United States. The focal point of the investigation is fatalities which occurred in the underground iron ore mines on the Marquette Iron Range in Marquette County, Michigan, between the years 1880 to 1979. Fatalities in the mines of this area were chosen to study because of the unique importance of their product to the early industrial progress of the country. Fatalities, rather than all accidents, were chosen as a measure of the social cost associated with the mining of these valuable ores because death represents the ultimate social cost. The raw fatality numbers were converted to fatality rates based on employment (fatalities per 1,000 employees) to provide a consistent unit of measure across decades, industries, and countries.

Since much of the underground mining occurred many decades ago, a historical case study approach was used. This was necessary in order to draw upon information as it existed at the time the ore was mined and the fatalities occurred. Material that was written and published at the time the fatalities were occurring gives valuable insight into existing conditions that produced or decreased the fatality rate. This insight cannot be gained from analysis of the numerical data alone. Particularly valuable are quotes from individuals directly involved in the mining venture. Because quotes are heavily relied on to support the conclusions drawn many have been included. Some of the quotes are provided in the text and some, although not of lesser importance, in the Appendix.

All data presented in this research are based on pre-existing material. No new data in the form of interviews or other first-hand information have been collected. However, much of the data used have not been published and throughout the study it has been necessary to either make estimates of various kinds or to adjust the data available in one form to a form more appropriate to meet the objectives of the research.

There has been no correlation of fatalities on the Marquette Iron Range with those occurring in other industries during the same time period, except in a very general sense. Also, there has been no attempt to explain changes seen in the fatality rates in industries other than that of the iron ore mining industry on the Marquette Range. There has been integration and correlation of the Marquette Range fatality rates and changes in them with contemporaneous economic, political, and legal events.

Source of the Data

The major portions of the essential numerical data (fatalities, employment, production) have come from the following sources:

(1) The *Ishpeming Iron Agitator* (which became the *Ishpeming Iron Ore* in September 1886 and will be referred to as the *Ishpeming Iron Agitator/Ore*). This weekly newspaper, from the heart of the mining district, provided the only available fatality data from 1880 to 1880.

(2) The Annual Report of the Marquette County Mine Inspector was the source of fatality data from 1889 to 1979. The Mine Inspector's report was also used to acquire employment data which was recorded in various ways from 1889 to 1979.

(3) The Michigan Commissioner of Mineral Statistics reports and the Michigan Geological and Biological Survey publications entitled "Mineral Resources of

Michigan with Statistical Tables of Production and Value of Mineral Products" were the source of ore shipment data until 1922. After 1922 production data was compiled for each active mine from the Annual Report of the Michigan Geological Survey entitled "Production and Value of Minerals and Mineral Products in Michigan" and from data obtained from the personal files of Robert Reed (deceased) of the Michigan Geological Survey. These reports entitled "General Statistics Covering Cost and Production of Michigan Iron Ore Mines" provided production data from 1926 to 1979). Supplemental shipment data were obtained from "Lake Superior Iron Ores," a publication of the Lake Superior Iron Ore Association.

The Iron *Ishpeming Iron Agitator/Ore*, Proceedings of the Lake Superior Mining Institute (LSMI), Michigan Bureau of Labor Reports, Commissioner of Mineral Statistics Reports, the County Mine Inspector Reports, and various other publications noted in the bibliography were used to acquire the information necessary to meet the second and third objectives. Heavily relied upon were direct quotes taken from these sources. It is felt that these provide the most valuable insight into the thoughts and attitudes that would reveal factors impacting the fatal accident rate and are the basis for interpretation of the trends found in the numerical data.

Presentation and Analysis of the Data

All significant numerical data have been presented as both tables and in graphic form. The fatality data have been manipulated into a form that is comparable across the entire time frame of the research, fatality rates. The examination of changes in the fatality rates is central to this research. The fatality rates have been graphed with respect to time, employment, and production and also compared with less qualitative

data such as changes in the legal, political, and economic realms. These comparisons, plus statistical analysis insofar as its usefulness is supported by the strength of the data gathered, reveal the trends necessary to meet the objectives of the research. A discussion of the difficulty encountered in the collection of the fatality data and an estimate of its reliability is given in Chapter 6.

This study considers only those fatalities which occurred underground; surface mining fatalities, insofar as possible, are not included. The initial period of surface mining occurred so early in the history of the Marquette Range that data on fatalities, if it could be found, would be extremely scanty and unreliable. Additionally, although surface fatalities certainly occurred, later data supports the conclusion that surface mining is far safer than underground mining. The number of fatalities which occurred on the surface is very low. Unfortunately, until 1913, the most reliable and complete data source for mine fatalities, the County Mine Inspector's Report, does not separate surface and underground accidents. By the late 1870s, most of the Marquette Range mines were underground in some form and the fatalities can be considered to have occurred there. The unavoidable inclusion of a few surface fatalities in the underground data is not considered to be a serious defect in the data.

The same problem is found with employment figures, the number of surface and underground employees was not separated by the Mine Inspector until 1913. However, it was found in a paper presented to the LSMI in 1895, that a ratio of 0.75 was used by mine officials to separate the total employment figure into surface and underground. 75% of the total figure represented the number of underground employees (Channing, 1895, p. 38). From comparisons of later data where both surface and underground

employment were reported this appears to be a very valid assumption and was used in this research to determine the number of underground employees from 1889 and 1913.

Some of the factors that contributed to the high fatality rates on the Marquette Iron Range for the decades preceding the 1920s have been put forth by various mining experts of those times (Immigrants in Industries, 1911, p. 332) and later analysts of the mining industry. They include:

1. Laxity in mine discipline and lack of managerial control of the miners and mine operation.
2. Demand for labor greater than supply resulting in the employment of inexperienced labor (Higgins, 1913, p. 65).
3. Absence of any laws forcing the companies to employ only trained miners in the responsible and dangerous occupations or to provide inspection of mines or mine equipment to ensure safe working conditions.
4. Lack of any laws forcing compensation for fatalities by the employer.
5. Inability of the majority of employees to speak English or understand the orders and directions given them.
6. Carelessness or recklessness on the part of many of the men employed.
7. Old technologies or mining methods used by a multitude of small companies or on the other hand, new technologies that provided new and unfamiliar dangers (Lankton and Martin, 1987, pp. 44-45).
8. Unavoidable "acts of God."

Using the data acquired, each of these factors will be assessed in terms of its positive or negative contribution to the fatality rate.

CHAPTER 3

HISTORY OF THE USE AND MANUFACTURE OF IRON AND STEEL AND THEIR RELATIONSHIP TO THE MINING INDUSTRY

Introduction

In order to assess the importance of and trends in the fatalities on the Marquette Range and prevent using their accounts merely as demonstrations of the evil of mining and mining companies, it is necessary to gain a historical perspective of the importance of iron and to understand the pressures put upon men, miners and mining companies, to produce the valuable metal ore. Gaining this perspective also helps to ensure the understanding that the acquisition of iron ores was not a trivial pursuit. Iron was a building block, a necessity for the development and advancement of civilization. It did far more than provide a select segment of society with superficial riches; it provided the very basis for the enrichment of the lives of all people.

Iron: The Essential Metal

As civilization advanced from the stone age and technology developed, there was an increasing pressure to produce more and more raw mineral ores both in kind and quantity. This pressure for production created the need for more men to mine the ores and also increased the cost and complexity of the mining operation. The pressure for production was particularly true with iron ores because iron, by virtue of its inherent physical characteristics and those that could be imparted to it, became the backbone of material and physical growth.

Very early in history iron was recognized as an essential metal. In the 6th century B.C. the philosopher Solon, when shown the treasures of the Lydian king Croesus told him, "He who hath more iron will be master of the gold." Spain, a vast empire, under Phillip II proved this Grecian philosopher correct. The treasury of Spain was filled with gold and silver from mines of the New World. Silver and gold were her symbols of power but the real elements of prosperity and power were lacking. England, on the other hand, possessed mines of iron and coal and the ability of her people to work them and utilize their products. Gradually this nation of miners and artisans surpassed her formal rival Spain in wealth and power. Spain could never achieve her former stature again (Lawton, 1903, p. 10).

That the iron industry is fundamental and is the basis for material progress of wage earning citizens is also pointed out in a 1903 paper prepared by Charles D. Lawton, then ex-commissioner of mineral statistics of Michigan:

> A large consumption of iron denotes that mines are actively working, that large numbers of men are busily employed at good wages in this calling. It denotes an increased demand for rails and hence the employment of large numbers of men in the rolling mills and in railway construction. It denotes the necessity for pig iron and hence the employment of increased numbers of furnace men, charcoal burners, wood choppers, coal miners, and coke makers. It shows that the builders of engines and locomotives, mining and milling and agricultural and other kinds of machinery are all busily at work. And thus the iron industry has its ramifications reaching into every other calling: It draws upon all and it depends upon all, and it sustains and benefits all, making its invigorating influence felt in every industry in the land (Lawton, 1903, p. 10).

The iron mining and related industries were not viewed with horror as killers of men. Rather, they were viewed as basic providers for men—something as fundamental and important to survival as agriculture.

History of the Use and Manufacture of Iron

Probably the first metallic iron used by humans came from meteorites. Imagine the following scenario: While searching for stones suitable for making tools and weapons, a prehistoric man came across a meteorite. It was markedly heavier than the rock materials with which he was familiar and when he tried to form it into a tool he found that it wouldn't break or chip but instead, with continual pounding, the odd material could be gradually shaped into the tool or weapon he desired. He soon found that an ax, for example, made from the material was heavier, stronger, and more resistant to wear than any tool he was able to fashion from stone. Desiring this new material because of the advantages it provided, he began to search for more.

Even the early name for iron indicates that meteorites were its primary source. In early Egyptian writings it is called "ba-en-pet," the metal from heaven. Because it streaked from the sky it was believed to bring luck, health, and prosperity to whoever owned a piece. However, iron in this form was also rare. Therefore, in addition to its practical usefulness, it was also incorporated into jewelry and used to signify wealth along with gold and silver.

The rarity of iron in the form of meteorites prevented widespread use of the unique metal until the discovery was made (also probably accidentally) of how to derive it from its ores. Metallic iron does not occur in significant amounts in the crust of the earth. It is instead chemically combined with oxygen, sulfur, or other substances into what we today refer to as iron ores. To be usable the iron must be extracted from its ores (i.e., the oxygen, sulfur, etc., driven off) otherwise it is useless. The process of smelting describes the extraction of a metal from its ore. Again imagine an ancient

scenario: One of the "rocks" in a fire pit is a piece of iron oxide. This is entirely possible because many forms of iron oxide are commonly found on the earth's surface, particularly in bogs and swamps. The carbon from the charcoal in the fire combined with the oxygen in the ore leaving metallic iron behind. This metallic blob caught the eye of our ancient man, who upon studying it, recognized it to be the same remarkable material found in meteorites.

From records obtained from Egyptian tombs, it appears that as early as 2000 B.C. extensive use of this discovery was made. Man soon routinely heated chunks of iron ore over a charcoal fire, intensified by the use of bellows, to produce a spongy mass of iron which could be made into virtually any type of iron tool, weapon, or implement. Its hardness, flexibility, and ductility far outweighed that of wood and stone materials. The use of the "wrought iron," as it came to be called, spread rapidly. Its chief disadvantage being limited production.

Iron production on any large scale had to await the development of the blast furnace. This structure, developed in early modern Europe around 1340 A.D., allowed the smelting of considerable quantities of ore. Additionally, the blast furnace allowed the attainment of temperatures high enough to produce molten iron. The ease with which this "cast or pig iron" could be formed in molds to make complicated, useful objects rapidly made its production a necessity.

The blast furnace was charged with three ingredients: iron ore (iron oxide), charcoal, and usually limestone. When subjected to intense heat generated by large bellows supplying blasts of air to the burning charcoal, the iron ore undergoes a process called reduction in which the carbon in the charcoal extracts oxygen from the

iron oxide. The melted limestone absorbs impurities and forms slag. The molten iron, being the heaviest ingredient, trickles to the bottom of the furnace and is drawn off into molds or "pigs" through a tap hole at the furnace base.

In the early 1600s, when English colonies were developing in America, iron making in the blast furnace was already a flourishing industry in Great Britain. The colonists, bringing with them the already developed techniques, quickly established many small "bloomeries" to produce wrought iron throughout what is today Massachusetts, New Jersey, Pennsylvania, and Virginia. In many areas iron ore was readily available, mainly in the form of bog iron ore, in deposits close to the surface.[3] In many colonial areas this ore could be scooped into flat-bottomed boats from the muck of swamps and bogs. Rock formations throughout the Appalachian Mountains were also frequently rich in iron ore. Limestone was abundant in many areas and near the coast seashells were often used as a substitute. And, of course, the vast forest supplied the huge quantities of wood needed to make the charcoal fuel.

The fuel supply offered by the colonies' endless forests soon tempted English ironmasters to invest in the growing American industry. In 1619 the first American blast furnace was constructed by English ironworkers at Falling Creek, Virginia, near a marshy area where bog iron ore could be dug. Tragically, the facilities were destroyed following an Indian massacre before production began. This massacre, claiming the

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[3]Bog iron ores are small irregular masses deposited along the borders of certain lakes and in bogs. They form as iron, dissolved from glacial sediments, is precipitated either chemically or biologically as earthy mixtures of yellow to brown ferric hydroxides. Bog iron ores occur in bogs or marshes as spongy masses mixed with peat and are abundant in the glaciated northern regions of North America and Europe (Pettijohn, 1957, p. 456).

lives of 348 men, women, and children, including 80 ironworkers may represent the first lives lost in the American iron ore industry (*Blast Furnace*, 1957, p. 6).

In 1644 John Wintrop, Jr., with English capital, established an ironworks and blast furnace at Braintree, Massachusetts, and in 1646 a much larger ironworks, known as Hammersmith, was built at Lynn, Massachusetts, on the Saugus River. Although the English-backed venture went bankrupt in 1668 it proved that cast (or pig) iron could be successfully manufactured in America (*Blast Furnace*, 1957, p. 7). This site has been dedicated as the birthplace of the iron (and steel) industry in America. Many owners of blast furnaces did quite well financially and by the time of the Revolutionary War there were probably more blast furnaces in the colonies than existed in England and Wales.

In England during the 1830s, techniques for using anthracite coal instead of charcoal for making pig iron in blast furnaces were developed. Although with their abundant supply of wood American ironmakers were slow in adopting these techniques, the opening up of the great anthracite coal beds in northeastern Pennsylvania gave them a cheap and plentiful substitute for charcoal and encouraged adoption of the new smelting technology. By the time of the Civil War there were more than 100 furnaces using the process, most of them located in eastern Pennsylvania (Lewis, 1976/1986, p. 25).

Because it was difficult to send heavy iron goods over the Allegheny Mountains in th early 19th century, a thriving ironmaking industry also developed at Pittsburgh. The first commercially successful use of coke for smelting took place in the late 1830s and the discovery of the Connellsville bituminous coal beds southeast of Pittsburgh produced a readily available fuel supply for the growing region. The heyday of

bituminous coal as a fuel for blast furnaces, however, did not occur until after the Civil War.

The adoption of European techniques, the availability and rapidly expanding use of anthracite in ironmaking east of the Appalachians, and the steady progress in the use of bituminous coal for ironmaking in Pittsburgh greatly increased the productivity of the American iron industry.

Correspondingly, the market for iron products in the United States grew enormously as the growth of cities, transportation networks, manufacturing enterprises of all types, and an increasing demand for a variety of finished goods relied more and more heavily on metal products. Machines that had once been made of wood were replaced by devices with iron frames and other metal parts. New forms of power required steam engines and turbines, and the spread of manufacturing provided a growing market for specialized metal tools of all types. Changes in agriculture encouraged the use of such metal parts as iron plowshares and components used in harvesting machines. Ocean-going steamships increased the demand for iron plate for hulls and railroads placed additional demand on iron manufacturers as the number of locomotives, railroad cars, and rails increased substantially. The increase in trackage from 2,818 miles in 1840 to 30,626 miles by 1861 clearly indicates the demand placed on the iron industry (Lewis, 1979, p. 31). There was also increased demand for wire for telegraph communication (before the later switch to copper) and for iron and steel cables.

The growth of cities also intensified the demand for iron; original wooden water lines were replaced by iron, urban dwellers required large quantities of metal heating

equipment and cooking stoves, and construction (especially as buildings increased in height) required a greater quantity and diversity of metal parts—nails, iron columns and beams, window sashes and door frames.

History of the Use and Manufacture of Steel

The superior properties of pig iron as it came from the blast furnace made it suitable for a great variety of uses. However, due to the relatively large amounts of carbon included in the metal it tended to be quite brittle and therefore unsatisfactory for uses which required greater tenacity, hardness, and strength under great stress, such as rails and railroad bridges, for example. In the early period of iron manufacture swords, fine cutlery, edge tools, and springs which had to be strong but light were unsatisfactory if made from pig or cast iron.

It was found that a slow, painstaking, and expensive process that reduced the amount of carbon to a tiny but critical percentage produced a suitable product—this was steel. Steel was produced in small establishments called fineries. In the 1850s an innovation in steel production appeared called the crucible method. This method was complex and costly but produced a better quality steel. However, the crucible method still did not allow the production of great quantities of the desirable material.

Steel is the most valuable form of iron and can be thought of as an alloy of iron and carbon in which the carbon varies between a few hundredths of a percent to 1.7 percent. Up to the Civil War almost all steel in the United Sates was made by the crucible method. However, its scarcity and high cost was becoming a significant problem. Most important was the need for rails able to withstand the pounding wear of heavier locomotives and cars which by 1863 wore rails out in less than two years.

In the 1780s a British inventor, Henry Cort, had developed a new process for refining pig iron to make steel that was cheaper and faster than the old method used in the finery forges. Instead of heating te pig iron in a charcoal fire, Cort melted it in a reverberatory furnace using ordinary coal, where the pig iron never came in contact with the coal. As the pig iron melted, it was stirred with an iron bar. As the stirring occurred the carbon in the iron was burned out through contact with the air. This process came to be known as "puddling."

The puddlingprocess was first used in America, using bituminous coal, in 1816-1817 at the Plumsock Rolling Mill in Fayette County, Pennsylvania, south of Pittsburgh (Lewis, 1976, p. 30). By the 1840s it was generally used for refining iron to produce steel.

Puddling was a hot, dirty, highly skilled job that required enormous strength but it was not particularly dangerous. A Department of Labor study in 1910 showed no fatalities out of a total of about 1,300 workers in puddling plants (U.S. Commissioner of Labor, 1913, pp. 32-33).

The Bessemer Process

The process that finally enabled the production of large quantities of steel at a low enough price to satisfy demand was developed in England by Henry Bessemer. Bessemer found that blowing air through molten pig iron produced temperatures at which the excess carbon in the iron could be burned away. If the air blast was stopped at the right time the result was steel. Bessemer presented his findings in England in 1856 in a paper entitled "The Manufacture of Malleable Iron and Steel Without Fuel" (Tech. Data Dept., General Motors, 1944, p. 17) and applied to various governments,

including the United States, for patents. The Bessemer process took place in a pear-shaped apparatus called a Bessemer converter. The reaction that took place in the converter as oxygen in the air combined with carbon in the iron was almost volcanic.[4]

A Bessemer converter "in blow" was picturesquely described by Holbrook (1939) in his book *Iron Brew*:

> One of the converters was in blow as we entered the shed. Tilted almost but not quite straight up, the mouth of it belched flame like a cannon built for the gods. It was a terrifying slight, and hypnotic. I didn't want to look elsewhere, to turn my eyes from that leaping flame which towered thirty, perhaps forty, feet above the converter.
>
> The roar was literally deafening; and little wonder, for here was a cyclone attacking a furnace in a brief but titanic struggle, a meeting in battle of carbon and oxygen, cleverly arranged by the sweating gnomes whose red faces appeared white in the Bessemer's glow. Both carbon and oxygen would lose, each consuming the other, and men would be the winners by twenty-five tons of bright new steel.
>
> The roaring continued. The red fire changed to violet, indescribably beautiful, and then to orange, to yellow and finally to white, when it soon faded. "Drop," the boys called. I saw the great vessel rock uneasily on its rack, moved with unseen levers by an unseen workman. A locomotive pushed a car close under. On the car was a big ladle. The hellish brew was done.

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[4]Historically interesting is the fact that William Kelly of Eddyville, Kentucky, also conceived of and developed a similar process. Although he failed to demonstrate that his ideas were commercially practicable he was able to prove that he had made steel by flowing air through molten pig iron several years before Bessemer and received a U.S. patent for the process in 1857. The problem was further complicated when Robert Mushet, in England, found a more dependable way to produce steel which often ended up as an undesirable completely decarbonized iron. With the Bessemer and Kelly process it was difficult to stop the "blow" (the air flow) at precisely the right time to leave the tiny amount of carbon necessary. Mushet found that a much more dependable result could be achieved by continuing the blow until all carbon was removed and then reintroducing the correct amount in a triple compound of iron, manganese, and carbon called spiegeleisen. Mushet's patent rights along with those of Bessemer and Kelly meant that to make steel in the Untied States by means of the new methods, manufacturers had to obtain permission from all three inventors. In 1866 several steel making ventures combined to buy all of the necessary patent rights (Tech. Data Dept., General Motors, 1944).

> Slowly the converter tilted over, and from its maw came a flow of seething liquid metal—Bessemer steel. A Niagara of fire spilled out, pouring into the waiting ladle, and sixty feet away the heat was too much for comfort. A cascade of sparks rolled out and over, a sort of spray for this cataract, and it seemed everything in the shed danced with light. In perhaps five minutes the ladle was filled with running fire. The bell on the locomotive rang. The ladle was pulled away, out into the darkness of the yard, and a sudden deep gloom settled down in the Bessemer shed. The devil's pouring was over. It is the most gorgeous, the most startling show that any industry can muster, a spectacle to make old Vulcan's heart beat faster, enough to awe a mortal (pp. 3-4).

As the Bessemer converters increased in size and higher blast rates were introduced, the Bessemer process became extremely dangerous. As the converters increased in height the more deadly "slips" became, where material in the furnace would hang up and then slip resulting in explosions capable of blowing the top off the furnace. Higher pressures and temperatures also increased the dangers of "breakouts," a rupture of the converter wall allowing molten metal to pour out. The Bessemer process was every bit as dangerous as it looked. In 1916 J. H. Ayers told the National Safety Council, "The adoption of the Bessemer process was accompanied by a great sacrifice of life and limb" (pp. 480-484). Not only was the mining of the iron ore a dangerous occupation, so was its transformation into a useful product—steel. Interestingly, it was actually the dangers of the steel industry that created the movement from which safer iron mining originated.

The Significance of Michigan Iron Ore In The Steel Making Process

The increase in steel production made possible by the Bessemer process could only be successful if the composition of the iron ore was of a certain chemical composition. As it turned out, the Bessemer process was suitable only for those iron ores that were low in phosphorous. Even though the possibility of nearly unlimited

steel production was at hand, the Bessemer process could not do away with phosphorous, an impurity which made steel extremely brittle, as had been true with carbon which the process could eliminate. Brittleness decreased the strength of steel in many applications and therefore limited its usefulness.

With respect to the demand for unlimited steel of high quality the most important development that took place in the growing American steel industry was the discovery of vast iron ore deposits in the northern peninsula of Michigan. This area, called the Marquette Iron Range, quickly became the major source of ore at Pittsburgh, Cleveland, and other locations where the Bessemer process was established.

The iron ores of the Marquette Range were uniquely important. Not only was cheaper lake transportation available to transport the ores to the blast furnaces, but also the Marquette ores were nearly free of phosphorous. These ores could be converted into the low phosphorous pig iron which the Bessemer process required. On the other hand, the established iron ore districts in the United States; in Pennsylvania, Alabama, and Tennessee contained ores with very high percentages of phosphorous.

In the late 19th century, then, the Marquette "Bessemer ores," as they came to be called, were essential to the rapidly growing steel industry which fed the industrialization of America. The great blast furnaces of Pittsburgh (the leading American steel making center) depended for their production on the Marquette iron ores. The completion of the Sault Canal and lock in 1855 also greatly increased the importance of these ores.

The Significance of Other Steel Manufacturing Processes to the Michigan Iron Ore Industry

Limitations of the Bessemer process, especially with respect to the composition of the raw ore that could be used, encouraged a search for other ways of making steel. This eventually led to the adoption of the open-heath method of steel production in America. The original open-hearth method of steel production was attempted in the 1840s in England. It involved using a reverberatory furnace in which heat was radiated into a metallic charge (the pig iron) without the charge ever coming into contact with the fuel. Early attempts failed because the furnaces could not produce high enough temperatures to produce large quantities of steel. The temperature problem was overcome by William and Frederick Siemens in 1856. The Siemens and Emile and Pierre Martin of France experimented with various combinations of ingredients in the charge and in 1868 the Siemens-Martin process, or the open-heath method, was introduced into the United States by Abram Hewitt, manager of the Trenton Iron Works in New Jersey (Lewis, 1976).

The great advantage of the open-hearth over the Bessemer method was that it permitted various types of scrap metal and other ingredients to be mixed with melted pig iron over an extended period of time. Small samples could be taken from the hearth at intervals for testing until a precise metallurgical composition had been obtained. While it was a much slower process than the Bessemer, its higher level of scientific accuracy resulted in a level of quality which the air blowing method could not match. Furthermore, open-hearth furnaces had a larger capacity and could be adapted to the varying nature of the ingredients with which they were to be charged.

Important to the Marquette Range iron ore industry was the fact that the basic open-hearth process eliminated much of the phosphorous from the steel. The process allowed the use of ores of more variable composition which decreased the market advantage for the low- phosphorous Marquette ores. In 1908 open-hearth steel surpassed Bessemer steel in total volume and never relinquished that lead.

Open-hearth technology was challenged in th early 20th century by the electric furnace. Powerful currents, sent through a metallic charge positioned between two electrodes, melted the ingredients with no possibility of contamination from the fuel. This allowed greater quality control and was particularly suited to the manufacture of alloys which required rigid standards.

By 1866 the United States had become the largest steel making country in the world with a gross output of 2,500,000 tons. This tremendous output was fed nearly solely by ore from the Marquette Iron Range. However, very important to the iron ore mining industry on Michigan's Marquette Range was the fact that the open-hearth method allowed the use of iron ore mined from the great deposits discovered in northeastern Minnesota in 1891 (the Mesabi Iron Range). These iron ore bodies, soft and near the surface, could easily be mined using the relatively cheap "open-pit" method, whereas the hard ores of the Marquette Range were deep underground which necessitated expensive shaft or underground mining methods. As the result of ever deepening mines and increasing expense on the Marquette Range, the Mesabi Range soon became the major source of ore for the American iron and steel industry in the 20th century.

Evaluation of Mining as a Critical Industry

As advancements in science and technology rapidly added to the diversity and quantity of the "necessities" of life, the demand for numerous mineral ores, in addition to those of iron, increased dramatically.

In the United States was found a prodigious supply of minerals and their use expanded quickly. Although the 20th century has witnessed a relative decrease in the use of materials containing minerals or mineral products: For example, the ratio of weight to power of steam boilers has decreased one-hundred times, cars, computers, and containers have become lighter and smaller and substitutes, such as plastics, have replaced many mineral products. Still, each year an average of 40,000 pounds of new minerals are consumed by each American (Ausubel, 1996). At this level of consumption, in an average lifetime, each American uses 800 pounds of lead; 750 pounds of zinc; 1,500 pounds of copper; 3,593 pounds of aluminum; 32,700 pounds of iron; 26,550 pounds of clays; 28,213 pounds of salt; and 1,238,101 pounds of stone, gravel, and cement. Additionally, each year energy equivalent to 30,000 pounds of coal must be generated for each individual (American Money Congress, no date, p. 8).

Without minerals and the sophisticated technologies they feed, Americans would still be striving to rise above the level of mere subsistence and there would be no hope for advancement in lifestyle for citizens of lesser developed nations. Mr. H. W. Scott, addressing the American Institute of Mining and Metallurgy (AIMM) in 1905 commented about American industrial progress since his youth and aptly described the mineral-driven nation:

> Industrial progress during this period has been so constantly accelerating, so intensified in purpose, so successful in attainment of ends that seemed but yesterday impossible, that a retrospect presents a record of miracles—of deserts a bloom, mountains removed, seas bridged, time out-speeded, distance a days journey!

Colorfully, but accurately he described the importance of minerals in this progress:

> Today I stand, with you, in awe of the fact that this young nation, banner in hand, leads in the front rank because of her unsurpassed mines of gold, copper, iron, and coal—most potential factors in the future of the world. Without these, the enterprise and genious (sic) of the American in industrial effort would be fataly circumscribed (Scott, 1905, pp. 9-10)

To support American industrial progress minerals, both fuel and non-fuel, had to be removed from the earth's crust because locked there they were useless. Again Mr. Scott's words accurately portrayed these facts: "These minerals, proven to be so abundant in the U.S., are not to be taken in situ as constituting wealth. They are valueless until utilized" (Scott, 1905, p. 10).

Remaining in the crust, minerals could not have driven the unprecedented technological change that has resulted in the industrialized, mass-production society in which we live today. It is the mining industry that provided the methods and machinery which enabled these valuable minerals to be removed from the earth and thus utilized. Mr. Scott also described the importance of the mining industry in his speech to the AIMM:

> The movements of civilization depend, mainly, and always on the products of the mines of the earth. Till ores could be smelted and metals could be had in quantities for the use of man, progress was practically impossible...The most careless thought will recognize at once how great a place the mining industry has among a means which have contributed to the progress of the human race. It is not too much to say that this industry has been, is, and ever will be, the indispensable basis of civilization and human progress. Every citizen—every child—of this

> republic is brought into daily contact and use of the products of the mines (Scott, 1905, p. 12).

In closing, Mr. Scott concluded:

> The function of machinery in this whole work is immense, and machinery depends on mines and ores and metals and coal to operate it. So without the products of the mines—were it conceivable they should be suspended—the world would stand still. It would lapse or sink to the primitive conditions of life from which the mines and metals delivered it (Scott, 1905, p. 13).

The Social Benefits and Costs of Mining

One of the most significant aspects of minerals, with respect to impact on society, is their acquisition. This is true because of the great social benefits and costs involved. The social benefits are numerous; the minerals themselves demanded by society to support an every-growing economy and the great improvements in living conditions which their use affords. The vast number of jobs provided by both the industries which acquire and use mineral resources enable large numbers of people to have the economic means to take advantage of an ever-improving lifestyle. And of course, the vast array and availability of material goods the basis of which is minerals and mineral products.

The social costs of mineral acquisition are more difficult to quantify because most do not have a real market price associated with them like the goods do that are manufactured from mineral resources. For example, the environmental impacts of mineral acquisition, such as deforestation, air and water pollution, and the associated health problems from which many miners suffer such as silicosis, black lung disease, lead poisoning, and those associated with physical injuries. And nearly always

forgotten (or ignored) are the social costs associated with the large numbers of fatalities that have occurred as miners remove these valuable minerals from the earth.

Underground mining, although essential, has long been recognized as an extremely hazardous industry. Generally speaking early mines were wet, poorly ventilated, hot, rodent infested, unsanitary, and dark. Without the benefit of modern machinery, human effort was the only means by which the metals vital to technological progress could be obtained. Consequently, in most underground mines during the early years of metal ore mining the conditions under which men labored were dangerous as well as unhealthy. In Cornwall, home to the Cornish pioneers of the American hard-rock mining industry early mining conditions are described by Arthur Todd.

> For the miner life was nasty, brutish, and short,....The sun shone on them only infrequently; their complexions were wan and sallow; their bodies were stunted with crawling on their knees along the narrow galleries and in the same cramped position hammering through the granite at the rate of no more than a foot a day by the light of a single candle. No less exhausting was the effort expended in reaching the rock face. In the days before the man engine, the only means of ascent and descent was by almost vertical ladders that were always wet and slimy and often had rungs broken or missing, a method of locomotion which used up as much as one fifth of their energy. Some mines were so deep that a man might have to climb continuously for an hour before he arrived "at grass," that is at the surface; and during this time it was more than likely that he would pass from temperatures of 80F and high humidity to the icy air of the main shaft before he began his walk home...After his long stint underground, confined within a narrow stope where the air was often fouled by the stench of human excreta, a miner's heart and lungs were never in good shape, and their gradual deterioration was a certain cause of accidents...Few constitutions could stand the strains of mining; more than half of the miners contracted silicosis; their working lives were finished before they were forty and few ever reached the age of sixty (Todd, 1995, pp. 16-17).

The Cornish miners brought to the Marquette Iron Range the knowledge necessary to develop the iron ore deposits discovered there. They and men of many

nationalities worked under conditions similar to those described by Todd and many lost their lives in the endeavor to obtain the valuable ore. These deaths are the social cost that this research intends to quantify.

CHAPTER 4

DISCOVERY AND DEVELOPMENT OF THE MARQUETTE IRON RANGE

Overview of the Region

The western Upper Peninsula with its rich resources of copper and iron ores did not have an auspicious beginning and without the bold vision of ambitious men the area may have wallowed in obscurity for years. In 1761, Alexander Henry, a British trader, settled at the Straits of Mackinac and subsequently traveled extensively throughout the region. Henry noted the extensive copper resources of the western Upper Peninsula but after viewing and taking a sample of a huge copper boulder near the Ontonagon River he wrote: "The copper ores of Lake Superior can never be profitably sought for but local consumption. The country must be cultivated and peopled before they can deserve notice" (Henry, 1809, p. 232).

With this writing, the picture of a remote, isolated area was born to be perpetuated well into and after the argument for including the western Upper Peninsula as a condition for Michigan's statehood. In 1835, as debates over Ohio's claim to the Toledo Strip raged in Michigan and Congress, the land was condemned as frozen, worthless, and not worth a dollar.

Lucius Lyon, Michigan delegate to Congress and former Surveyor General of the United States, wrote:

> ...the (Senate Judiciary) Committee will probably give us a strip of country along the southern shore of Lake Superior, where we can raise our own Indians in all time to come and supply ourselves now and then

with a little bear meat for delicacy (Michigan Pioneer Historical Collection (MPHC), 1897, pp. 477-478).

All in all though the region had an ally in Lyon who, in a letter to Senator Charles Hassall in 1836, prophetically wrote:

> This will give Michigan about 20,000 square miles of land,...which may at some future time be esteemed very valuable. A considerable tract of country between Lake Michigan and Lake Superior is known to be fertile and with the fisheries in Lake Superior and the copper mines supposed to exist there may hereafter be worth to us many millions of dollars. At any rate it can do us no harm and I am in favor of getting it while we can, for at least, if we are cut down on the south as we certainly shall be, our State will be quite poor and small enough (MPHC 27, 1897, pp. 479-480).

The *Detroit Free Press*, however, took a vehement anti-Upper Peninsula stand, evidently mirroring the sentiments of its readers:

> If the committee in Congress who reported the Dismemberment Bill imagine that the people of Michigan can be reconciled to its provisions by extending their jurisdiction over the region of perpetual snows—the ultimate Thule of our national domain on the north—they are much mistaken...We have made it our object to ascertain the feelings of our citizens on this subject... (*Detroit Free Press*, March 23, 1836).

But in spite of protests, in January 1837, Michigan was admitted to the Union, the western Upper Peninsula annexation, with its barely acknowledged valuable resources, attached.

This isolation, the feeling of far-away outpost which pervaded the region, is a factor in the evolution of the mine fatality story. If nothing more, it helps explain the paucity of reliable information on the mine fatalities. They were simply unknown and unreported. The population was sparse, travel difficult, and communication poor. To extract the valuable ores, development of the area was paramount, the fatal mine accidents being no more notable than drownings in transport on the lake, death due to

disease, freezing, lumbering accidents or a host of other perils that pervaded the isolated wilderness. Additionally, the new mining population was basically made up of immigrants, many with no relatives to notify or even no certain name or identification. Their deaths simply went unnoticed.

George Newell, speaking to the LSMI in 1909 described the area around 1851 as the mining industry developed:

> A dense, unbroken wilderness, isolated hundreds of miles from the outermost confines of civilization, with no means of approach or of return, except by water in summer, and over snow, through interminable forests in the long dreary winter. Severe in clime, presenting in its unpenetrable cedar swamps, sterile sands and denuded granite, a most uninviting aspect (p. 21).

And in 1903 Charles Lawton in the Michigan Miner stated:

> The people of lower Michigan were obliged to think twice to include the Upper Peninsula as part of the state, and when they did recognize it they looked upon it as a part of a foreign possession, an outlying province that came into our fold through a bad bargain which we were constrained to accept by the pressure of the general Government...This was not to be wondered at because it was a wilderness and inaccessible (p. 11).

Until 1855 the lack of transportation facilities prevented any real development of the region. Commenting on the development of the area's resources, Major T. B. Brooks of the Michigan Geological Survey noted:

> There was no dock at Marquette, no canal at the Sault, scarcely a road in the country, no shop for repairs, no skilled labor but what was, together with all supplies, imported from below, and no regular communication (T. B. Brooks, 1875, p. 21).

During the summer of 1849 only three sailing vessels and five propellers came to Marquette. At the Sault were impassable rapids. Whatever goods were shipped to or

from the region had to be unloaded there and hauled over the portage. The process was slow and cost prohibitive.[5]

Thus, in the 1840s the Upper Peninsula of Michigan was as remote a place as could be imagined. In speaking against a canal at the Sault before Congress in 1842, Henry Clay expressed this remoteness as he argued that the project "contemplated a work beyond the remotest settlement in the United States, if not on the moon." But government surveyors and geologists were slowly discovering what had previously been only rumored by the Indians and later embellished by French and English explorers and fur traders for some 200 years—the presence of rich deposits of native copper and iron ore.

Discovery of Iron Ore on the Marquette Iron Range

In mid-September of 1844, William A. Burt, U.S. deputy surveyor and his party were extending the Public Land Survey over previously unexplored land in Michigan's Upper Peninsula along the east boundary of Sections 1, 12, 13, and 24 in Township 47 North, Range 27 West when Burt recorded the following observations:

> East boundary of T47N, R27W. This line is very extraordinary on account of the great variations of the needle...On sections 12 and 13, variations of all kinds, from S87E, to N87W. In some places the north end of the needle would dip to the bottom of the box, and would not settle anywhere. In other places it would have variations of 40, 50, and 60 east, then west variation alternating in a few chains. Camped on a small stream in Section 13 (Hatcher, 1950, p. 23).

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[5]It is interesting to note that even today, the Upper Peninsula is viewed as isolated from the rest of the state. Its great economic and cultural history remains unknown to many current lower peninsula residents. In 1983, Bruce Johnson of Ontonagon told Mary Ann Harsell in an article in *National Geographic*, "this is not the edge of the world, but you can see it from here" (Harsell, 1983, p. 92).

Interestingly absent from Burt's notes is any hint of excitement or understanding that he was walking over one of the greatest deposits of iron ore in the world. This iron ore (along with Michigan's already known copper deposits) would be the backbone of the transformation of the United States from an agricultural nation to the leading industrialized nation in the world.

At nearly the same time as Burt's survey Michigan's first state geologist, Douglass Houghton, was investigating the mineral wealth of the Upper Peninsula. Although primarily interested in copper, Houghton's report of 1845, prepared after his untimely death by his assistant Bela Hubbard, contained a detailed description of the iron ore deposits in the Negaunee-Ishpeming region—the same area Burt was surveying.

> The largest extent of iron ore noticed, is in T47N, R26W, near the corner of Sections 29, 30, 31, and 32...Here there are two large beds or hills of ore, made up almost entirely of granulated, magnetic and specular iron...This bed of iron will compare, favorably, both for extent and quality, with any known in our country (Hatcher, 1950, p. 31)

Initial Development of the Iron Ore Deposits

Growing knowledge of the mineral wealth of the region stimulated the spirit of young American enterprise. By July 17, 1846, almost 1,000 mineral leases had been granted in the iron rich area, and 104 mining companies formed to exploit the mineral riches of what was to become the Marquette Iron Range. The answer to why men would ravel to this isolated, remote, hard-to-reach region populated only by small bands of Indians, large swarms of mosquitoes and viciously biting blackflies in the summer, with months of winter that produced 25 to 30 feet of snow lay in the growing importance of iron, the vision of these early pioneers, and, of course, the hope of

obtaining wealth and comfort. From rapidly spreading reports from the region, men expected to find this valuable metal so plentiful that the quantity would more than make up for its base character. Aside from the fact that these men dreamed of riches in tons rather than troy ounces, they were no different than those who braved incredible hardships to make their fortunes in California gold.

The iron riches of the Upper Peninsula were, however, different from those of the California gold fields in that the chance for instant wealth did not exist. Only through perseverance, hard work, and the investment of large amounts of capital would the iron ores of Lake Superior become an important resource and return any profit to those who sought them.

> The collection of minerals I have brought from the regions of Lake Superior have turned the heads of most of those persons who have examined them [wrote Douglass Houghton in 1840], but it is not so with myself, for I know full well the many difficulties and embarrassments which will surround the development of the resources of this district of (the) country (Hyde, 1998, p. 29).

Among those securing leases was Philo M. Everett, a merchant from Jackson, Michigan. Everett and several of his neighbors formed themselves into the Jackson Mining Company and in the summer of 1845 four of the group (including Everett) set out for the Upper Peninsula, actually hoping to find copper and gold. At the Sault Everett's group met Tipo-Keso, a Chippewa Indian woman, who told them of a place where great blocks of heavy rock lay on the open ground. The place was close to what is today called Teal Lake, near the present city of Ishpeming. Upon arriving at the Chippewa Indian camp on the lakeshore, Everett's party was led by Chief Marji-Gesick to a fallen pine tree where, under its roots, the "heavy rock" was exposed—what

appeared to Everett's party to be very rich or high grade iron ore (i.e., ore containing a very high percentage of iron). Samples returned by Everett to ironmasters in Pennsylvania were pronounced useless and the venture seemed to be a failure. It would later be shown that it was the ironmaker's furnaces, not adapted to this high-grade ore, that were the failure.

Not easily discouraged, Everett's party again explored the region the following spring of 1846 and a log cabin was built near the pine stump. This became the site of the Jackson Mine where the first iron ore from Michigan was mined. The mine was located south of Teal Lake where the iron formation formed a huge outcrop, then called Iron Mountain. Ore samples from this expedition were sent to an ironmaker who produced a bar of high-quality metal—the first iron ever made from the Marquette Range ore. There was now no question of the quality of this iron ore.

Mining on the Marquette Range: Overcoming Adversity

In 1847, the Jackson Mining Company built a small forge on the Carp River near the Jackson Mine and in February of 1848 Ariel N. Barney forged the first iron ever made on the Marquette Range. The operation lost money but it proved the fine quality of Lake Superior ore and publicized the location far and wide.

Companies were formed overnight. Claims were secured without definite boundaries and without knowledge of their value. Iron mining stocks were sold in a world market. However, failing to heed the warning issued by Douglass Houghton in one of his first reports on the mineral resources of the peninsula, very few of the 104 companies that existed as of July 1846 survived or even got into operation. Although Houghton was writing about copper and gold when he cautioned speculators that the

lure of quick wealth would "prove the ruin of hundreds of adventurers, who will visit it with expectations never to be realized," his warning proved prophetic for the iron resources as well:

> I would by no means desire to throw obstacles in the way of those who might wish to engage in the business of mining this ore [wrote Houghton], but I would simply caution those persons who would engage in this business in the hope of accumulating wealth suddenly and without patient industry and capital to look closely before this step is taken, which will most certainly end in disappointment and ruin (Krause, 1992, p. 134).

Still convinced, despite the failure of the Jackson Company forge, that pig iron could be made near the mines, the Marquette Iron Company (established in 1849) opened a forge on the bay at Marquette in 1850. The fledgling effort was spearheaded by the indomitable energy of Robert Graveret, however, the company soon became victim of financial disaster. Although Graveret possessed the qualities of vigor, courage, and imagination necessary to open the formidable wilderness to iron mining, he lacked practical experience in business. Additionally, the logic of shipping raw iron ore to the iron making industries near the coal fields in Pennsylvania and Ohio rather than producing and shipping pig iron from the mines was yet to be seen.

In December 1850, the Cleveland Iron Company was organized and acquired by the Marquette Company, along with its forge, in 1853. Like the Jackson and former Marquette companies they had no thought of shipping raw ore. The Cleveland Mine was located about two miles west of the Jackson Mine at another large outcropping of ore called Cleveland Mountain. To many, the prospect looked desolate as both existing companies were losing money. There were problems on every hand but the greatest was transportation. It began at the mines where the ore was wheeled out by hand to the

stockpiles. From the mines the problem increased to the forge and dock at Marquette and compounded from there.

The mines were located near the present day cities of Negaunee and Ishpeming 12 miles inland from the harbor at Marquette, and there were no roads (see Figure 1). It was impossible to move the heavy ore during the summer and the companies had to wait for winter and snow to provide a surface on which to move the ore by sleigh.

The terrain also posed a problem. Marquette was half circled by steep, densely wooded hills and outcropping granite knobs. The trails from the mines to the harbor were so steep and tortuous that a team of horses was able to make only one round trip per day (Hatcher, 1950, p. 61).

Also, there were no ships designed to haul the pig iron from Marquette down Lake Superior. The companies actually had to wait for a captain who was willing to take some of it as cargo. Then at the 19-foot falls at the Sault the heavy iron had to be unloaded, hauled around the falls, and reloaded. Here, again, there was a lack of suitable ships to haul the iron blooms to the Ohio and Pennsylvania markets.

The transportation problem was compounded by the very short navigation season which limited shipments into and out of the area to about six months of the year. In addition to shipping the iron out, literally everything had to be brought by schooner into the isolated region: food, mining and building supplies, laborers, animals, food for the animals, everything one could think of. Twenty-one days were required to make the trip from the Sault to the mouth of the Carp River at Marquette in 1845, and the lack of a piece of equipment or essential supplies could easily shut down an operation for nearly a year. With scarce and expensive labor it cost the Marquette

Iron Mining Company $200 per ton to make and deliver a ton of pig iron at Pittsburgh when the market price was only $80 per ton (Hatcher, 1950, p. 45).

The first transportation problem that had to be solved was that from the mines to the forge at Marquette. After the failure of Heman B. Ely to finance and build a railroad from the mines to Marquette, the Jackson and Cleveland Iron Companies, in 1852, jointly undertook the laying of a plank road from the mines. By November of 1855, a strap railroad was extended from the mines, over which mules could pull a car containing about 4 tons of ore. Although the road was steep, rough, and difficult for horses and mules to negotiate it provided a solid surface on which to move the heavy ore from the mines to the forge at Marquette (Hearding, 1936, pp. 174-175).

Another problem, and probably the greatest obstacle to getting the iron to market, was removed in 1855 by the completion of the Sault Canal. The Canal, costing just under $1 million, was probably one of the best investments made in the future of America. The new canal greatly increased the efficiency of direct shipping of raw ore to the furnaces in the lower lakes where coal resources were also located. This immediately brightened the future for the ore producers. Also about this time (1855), recognizing that there was no coal near the region and that in the future a lack of timber would make charcoal for the forges too costly, a move was on to develop facilities for shipping raw ore rather than pig iron. The profitable future ahead was indicated by the fact that the Cleveland Company shipped 1,449 tons of ore in 1855 and 11,297 tons of ore in 1856 (Hatcher, 1950, p. 66).

However, it still remained to improve transportation from the mines to the docks at Marquette. A steam railroad with iron "T" rails was finally completed by

Heman Ely and his brother Samuel, and in September 1857 the first steam locomotives on the iron range, named Sebastopol and C. Donckersley, hauled 1,200 tons of ore daily from the mines.

In June of 1859 another obstacle to the success of the Marquette Iron Range was removed when the first semblance of a modern dock, built by the Cleveland Iron Company, was opened at Marquette. The first docks, periodically washed away by the storms on Lake Superior, required workmen to push wheelbarrows of ore out onto the dock and then wheel the ore aboard the waiting schooners. This was a slow, laborious, and expensive process. It took 3 to 5 days to load 400 tons of ore (Hearding, 1936, pp. 174-175). After the ore was loaded it had to be hand trimmed, which was an exceedingly laborious task, especially in hot weather. The unloading was an even more arduous task. The new dock had a trestle on which the railroad cars loaded with ore could run out and dump their load into ore holding pockets which slanted out over the hatches of vessels moored to the dock.

That the idea to ship raw ore rather than pig iron and the effect of the combination of increased efficiency in transporting the ore from mine to dock and from dock to a growing market that could take all the ore the range could produce and deliver can be seen in the mine production. Up to 1855 it is estimated that about 25,000 tons of ore had been taken from the Jackson Mine and around 5,000 tons from the Cleveland which employed at that time only about a dozen men (Hatcher, 1950, p. 81). About 7,000 tons were taken out of each mine in 1856 and over 25,000 tons in 1857. The depressed economy of the panic of 1857 was reflected in the ore output for 1858—22,876 tons, but in 1859 it rose to 68,832 tons and in 1860 it rose to 114,401

tons. About one-quarter of this 1860 production came from a new Cleveland Iron Company Mine called the Lake Superior (Hatcher, 1950, pp. 81-82).

With the new, more efficient transportation the cost of shipping the ore from the mines also greatly decreased making the Range an even more viable venture. In 1855 it cost operators $3.00 per ton to ship ore from the mines to Marquette and $5.00 per ton from Marquette to the Lake Erie ports. But by 1858 the rate from Negaunee to Marquette had gone down to $0.87 per ton and from Marquette it had fallen to $2.09 per ton (Hatcher, 1950, p. 82).

It is obvious that men of long-range vision, managerial skill and experience, and financial acumen were needed to make a success of mining ventures in this remote wilderness. But for their perseverance, this vital resource would have remained in the ground and the United States would have been committed to remaining an agricultural nation. What possessed the men who were successful on the iron range? Certainly it was not the glitter of instant wealth, because those who recognized the potential of the resource also recognized the amount of investment that would be necessary to recover it. The successful "iron men" did not believe they would get rich quick, in fact, most were already wealthy. What they had was a deep belief in the importance of the ore deposits to the future of America and that control and mining of these deposits would eventually pay with handsome profits and personal power. The stakes were high—they were gamblers.

With the greatest barriers removed, the iron ore industry of the Marquette Range became firmly established and two diverse groups of men would be responsible for its success—the mine owners and the miners. The former group risking large

amounts of capital and business investment, the latter accruing risk in the form of fatal accidents that occurred regularly in the mines as men worked to ensure the future of the iron ore industry in Michigan. A brief understanding of the growth of the mining industry provides valuable insight into the fatal accident problem and will help answer some questions as to the causes of these accidents.

The Fledgling Industry

The ore, concentrated in an area some 35 miles long, stretching west from Negaunee nearly to L'Anse (see Figure 1), and three to seven miles wide, was found in separated pockets. As each pocket was found, a new mine developed and became a "location"—a cluster of homes, boardinghouses, and sometimes a store around the mine. These communities were no exception to the isolation of the area. They were separated from each other by dense forest and rocky terrain, and each was more or less self-contained. Transportation between them was over rough trails by horseback or foot.

In many places the rich ore occurred right at the surface. It merely had to be broken up and hauled away. After sand, dirt, and boulders were stripped off the surface the men hammered two-inch drills down 15 to 22 feet through solid rock with sledge hammers. They then filled and tamped these drill holes with black powder and blasted loose large pieces of ore. These pieces were picked and hammered into the proper size and loaded by hand into carts. The carts were pulled by horse or mule to the railroad where tram cars were loaded to be sent down to the ore dock. The richness of the deposits and their occurrence at or very near the surface required little initial outlay of capital. The work was hard manual labor but of the simplest and safest kind; a pick and

shovel, hammer and drill, black powder, horse and cart operation that required little skilled labor was a plus in this remote district.

The Effects of the Civil War on the Mining Industry

It was a timely historical event which gave great impetus to the success and growth of the iron ore industry on the Marquette Range, the Civil War. An increase in demand for iron goods of all types was precipitated by the war. The armies of the North carried guns and used cannons made from the finest and strongest iron from Marquette ore and rails made from this ore spanned the northern states as blockades of the Mississippi detoured traffic through the north. When the Civil War began, there were three mines in operation (The Jackson, Cleveland, and Lake Superior) run by two companies. These companies, the Jackson and Cleveland Iron companies made great profits from the war. The price of ore early in 1864 averaged $4.15 to $5.60 per ton but by 1865 had climbed to $7.50 per ton (Mussey, 1905, p. 59). The New York, Marquette, and Lake Angeline Mines went into production in 1864.

After a slight recession in 1865, the next eight years showed a fantastic growth in ore production reflecting the rapid industrial growth of the country that took place after the Civil War. The price for ore (standard Bessemer) reached $12 per ton in 1873. The high price of ore made the worse mining possible. The effort was to get the ore out, not improve methods. The method was exploitation, pure and simple. Also, the number of mines producing ore increased rapidly. The Humbolt, Iron Mountain, and Washington appeared in 1865, and the Edwards and New England in 1866. Three more were added in 1868 and by 1873 ore was coming out of 40 open pits scattered around

the Ishpeming-Negaunee area (Hatcher, p. 93). However, the days of cheap reckless mining were coming to an end.

The ore sloped downward and the overburden became too thick to remove cheaply. At these sites the miners followed the ore downward and the open pits became underground quarries, like a mining operation in a cave. Knowledge of how to mine the ore in this manner became more important as the operations continued downward. The miners built inclined skiproads to haul the ore out into the open and had to support the roof by leaving pillars of ore under it if there was danger of it collapsing. This also greatly increased the cost of handling the ore since now pumping and hoisting machinery became a necessity. In 1873, one mine worked underground but within seven years underground work was the rule (Mussey, 1905, pp. 76-77).

Companies on the Iron Range multiplied rapidly and by 1873 the mines were at the peak of their prosperity. Several companies were involved in the ownership and operation of these mines, one of which was the Iron Cliffs Company founded in 1864. Iron Cliffs and the Cleveland Iron Company would eventually merge to become one of the largest, most persistent companies on the range.

Tonnage figures tell the story of the growing demand for Marquette iron ore (Hatcher, p. 93):

1862	124,169	1868	510,505
1863	203,169	1869	649,097
1864	247,059	1870	856,245
1865	193,758	1871	818,966
1866	296,713	1872	949,073
1867	465,504	1873	1,174,972

In 1870 common labor received $1.80 per day and miners around $2.12 per day. It cost $2.64 to mine a ton of ore with a total cost of $3.50 per ton to place it on the ore cars for shipment from the mine (Hatcher, p. 117). However, the law of diminishing returns was at work. The cheaply obtainable ores were quickly being mined out and it was necessary for the mines to extend deeper and deeper underground. The deeper they went the more expensive the mining operation became. Coupled with the changes necessitated by this major change in mining method was another event that was far beyond the control of the mining companies.

The Effects of the Panic of 1873

In 1873 a major change took place in the Marquette Range iron ore industry as a result of the financial panic that shook the nation that year. Following the greatest boom in the country's history, when mines were worked to the limit day and night and speculators opened mines into an ore body without any previous determination of its extent or value, suddenly the demand for ore nearly ceased. Many smaller mines failed, selling their properties to a few strong companies who had the capital necessary to bear the increased cost of underground mining and survive the depression. For these strong companies the depression eventually worked to their advantage. Not only did the depression force out the smaller producers on the Marquette Range, decreasing competition, it also contributed to the decline of the eastern iron producers and the rise of the mills in Pittsburgh and Ohio to which the Lake Superior mines had the advantage of cheap, convenient lake transportation.

The surviving companies also benefitted from the rapid substitution of steel for iron due to the success of the Bessemer process which increased the demand for the low

phosphorous ores of the Marquette Range. In fact, the growing Bessemer steel industry stopped the downward trend in ore prices due to the depression enabling the few remaining producers to more easily bear the increased costs of the deepening mines.

The depression also benefitted the larger remaining companies on the Range by forcing them to abandon the old, haphazard, costly methods of mining. Due to the need to control costs, the companies were forced to adopt more efficient, scientific procedures and practices.

The Post Panic Years

As the Panic waned and the demand for Marquette Bessemer ore increased rapidly at Pittsburgh, the number of mines increased rapidly from 29 in 1875-1877 to 55 in 1878. By 1879 there was a seemingly unlimited demand for Marquette ore at Pittsburgh. The price of ore rose to $9.50 per ton and shipments from 1878 to 1882 increased 80% (Mussey, p. 79).

By 1878, several mines were underground on the incline, and several had actual shafts to reach the ore bodies. The Cleveland Mine had a shaft and four levels by 1877. The great shaft mine era was well underway (Hatcher, p. 128).

A new lock at the Sault, built in 1881, decreased shipping costs, giving a margin for reduction in the price of ore which hastened the deepening of the mines. In the shaft mines heavy expenditures had to be made before any profit could be realized. Men of skill and knowledge were required to guide these operations and intelligent and experienced miners were needed underground. On the surface expensive machinery was needed to run existing operations and discover new ore bodies. Cleveland Iron Company began to use the diamond drill to outline ore bodies not exposed at the

surface and to forecast future mining plans. By 1876 steam-driven power drills appeared on the Marquette Range as well as steam hoisting and conveying equipment, pumps, ventilation systems, and lighting. By 1878 Republic Mine was using compressed air to improve ventilation. Use of compressed air marked the transition from old methods to modern electric power. The first electric lights appeared underground in 1880. Many mines substituted mules for manpower to tram ore underground, some also used slow moving, endless cables. Electric haulage appeared underground first at the Cleveland Mine in 1892 and then at Lake Angeline Mine in 1893. Steam and electric power increased ore output per man hour and reduced the cost of "dead work" (Hatcher, pp. 132-144).

Mining methods also changed which made work more efficient as well as safer. The old open stope gave way to the "square set" method. By this method a lining of timber replaced the ore as it was removed, but the method wasted ore and timber and required a large number of men to build the "sets." The "sets" were often hastily or poorly constructed and at times collapsed under the weight of falling rock. Transporting the large timbers underground was also a source of danger.

The caving method was first used at the Cleveland Hematite Mine in 1881 (*Ishpeming Iron Agitator/Ore*, September 12, 1891). This method was safer and much more economical in that fewer men were required, the necessity for timbering was less, and the amount of ore that could be removed was greater.

Coming out of the Panic of 1873, iron mining on the Marquette Range was no longer for the amateur. Millions of dollars in capital had to be provided to set up machinery and equipment. The industry moved toward consolidation with a few

companies, commanding large resources, replacing a multitude of small firms. To succeed these companies had to offset increased capital investment by lowering mining costs.

The Effects of Competition

As the country emerged from the Panic, competition for the existing companies on the Marquette Range also increased as new iron ore deposits were found. In 1874 the first shipments were made from the Menominee Iron Range in the western Upper Peninsula. The Gogebic Range, also in the western Upper Peninsula, was opened in 1884. As these new ranges came into production, the mines on the Marquette Range were getting deeper and more expensive to work. Timbering, pumping, and hoisting continually added more to the cost of mining the deep ores. Within the next ten years, new ore deposits, suited to the cheaper open pit mining methods, would also be discovered on the Vermilion and Mesabi ranges in Minnesota (see Figure 1). Slowed in development by the financial panic of 1893, the Mesabi quickly recovered when the steam shovel was introduced to the range in 1894. From that time on the direction of the Mesabi Range evolution was obvious and inevitable. This new competition would demand far reaching changes in the companies that had been operating on the Marquette Range for nearly 40 years.

By 1883-1884, competition from the Menominee and Gogebic ranges had forced the price of ore down to $5.50 per ton. It stayed at this lower level until the Panic of 1893 when it declined even further. During this time, however, production on the Marquette Range had increased dramatically and the cost of production had reached an all time low (Mussey, p. 100).

Even before the Mesabi Range was discovered, the opening of the Menominee and then the Gogebic and Vermilion ranges in the 1880s made it obvious to Cleveland Iron Company's Samuel Mather that the continued success of the Marquette Range lie in even further consolidation. The independent companies remaining on the Range needed to merge into organizations large enough to command vastly increased capital resources. This would permit new economies of scale and lower production costs. With increased competition as impetus, the two largest companies on the Marquette Range, Cleveland Iron Company and Iron Cliffs Company, merged in 1891 to form Cleveland-Cliffs Iron Company under the direction of William Gwinn Mather, Samuel's son. The merger brought under one management the control of most of the important mineral lands in the Marquette district and gave the new company a more favorable competitive position, combining nearly 40 years of mining experience. The historic Jackson Company was added to Cleveland-Cliffs Company in 1905. Additionally, two other large companies leased and ran mines on the Marquette Range—Pickands, Mather Company beginning in 1883 and Later M. A. Hanna Company, 1922.

The Effects of the Panic of 1893

In 1893 the bottom again dropped out of the iron ore industry due to the Panic of 1893. In 1893 the Marquette specular Bessemer ore price was $4.50 per ton, $1.00 below the lowest price ever. It was $3.35 per ton in 1894, lower in 1895, recovered to $4.50 in 1896 but fell below $3.00 per ton in 1897. It wasn't until 1900 that the price of ore rose above $3.50 per ton again (Mussey, p. 125).

The Panic, with low prices, precipitated even a greater combination of mines under the ownership of large companies. Several mines were transferred to the

ownership of large steel manufacturers who had begun to see that economical operation required ownership of both ore and coal supplies.

By 1899, the independent producer was just about eliminated from the Marquette Range. Cleveland Cliffs Iron Company remained the oldest independent company on the Range (Mussey, p. 138). William Mather summed up the emerging situation in 1898 at the annual meeting of the Lake Superior Mining Institute (LSMI):

> The Lake Superior mining industry is now in the era of the large corporation or employer, whose organization is as costly as it is efficient; whose fixed expenses are large and whose aim must therefore be to work regularly, to produce this year as much as, if not more than, last year, so that these fixed charges per ton may not increase, but decrease. The employer cannot now easily reduce his cost when prices and demand are depressed; a complex organization (necessary with a large business) cannot conveniently nor economically be suddenly adapted to a decreased output; men cannot be discharged now and new ones employed later without impairment of system, discipline and efficiency; taxes will not grow less since large communities have grown up in what was once a wilderness (pp. 10-11).

By way of illustration Mather offered the following data; In 1882 41 employers produced 1,829,394 tons of ore or 44,619 tons per employer. In 1893 22 employers produced 1,835,913 tons of ore at 83,449 tons per employer. And in 1897 only 18 employers produced 2,715.035 tons of ore at 150,835 tons per employer. This increase in total production of 320% was accompanied by a reduction in price from $9.50 per ton at Cleveland in 1883 to $2.35 per ton in 1897 for the same grade of ore. It was obvious that a huge scale of operation was necessary to produce ore cheap enough to counterbalance the lower price (pp. 11-12). It was a unique combination of personality, managerial skill, business acumen, and labor that kept the Marquette Range alive against great odds.

Geography helped the mines also. First, the Marquette area mines had the advantage of a short rail haul (12 miles) to the loading docks at Marquette. Rail haulage, as compared with water transportation, was exceedingly expensive and the distances over which the ore had to be transported to market were great. Rail distances from the Mesabi to the head of Lake Superior were long, 42 miles from Mountain Iron to Stony Brook and then to Duluth. Secondly, the water route to the steel mills was 810 to 834 miles from Duluth and only 598 miles form Marquette. The resulting lower transportation costs from Marquette helped offset the higher costs of underground mining.

Additionally, although the Mesabi ore was rich in iron the blast furnaces of the day were designed to handle the hard ores of the Marquette Range. It took 15 years for the furnace men to learn how to use the soft ores except as a small portion in a mixture with the hard Marquette Range ores. The Marquette ores remained a necessary ingredient.

Competition and financial Panics had immense impact on the Marquette Range mining business. The deepening of the mines which had occurred in good economic times, in the long run, greatly increased the cost of mining while competition reduced the price of ore. These factors that fixed costs of the industry could never be increased and the mine managers were always forced to look for cost cutting methods; reduction in fatal accidents was one such method.

CHAPTER 5

LITERATURE REVIEW OF FATAL WORKPLACE ACCIDENT RECORDING AND REPORTING

Introduction

As the data collected will show, the number of deaths associated with underground mining on the Marquette Iron Range decreased over the study period. In order to correctly assess what this decrease implies and in order to use the changing fatality rate as a meaningful measure of social cost, an accurate measure of the raw number of fatal accidents that occurred is desirable. However, although information sometimes seems to be abundant it is, in fact, very difficult to find accurate data. Early estimates of work-related fatalities are extremely variable and highly suspect with respect to accuracy and even today work-related fatality data is inaccurate, often contradictory, and confusing. It is appropriate here to discuss some of the general findings regarding the reporting and recording of workplace fatalities in the United States. This will help give an understanding of the great difficulty involved in trying to acquire reliable data (or any data) concerning deaths in the iron mines on the Marquette Range, especially in the early decades of the industry.

Fatality Statistics: Reporting and Recording

Although there has been a spectacular growth of industrial casualty reporting since the late 1960s, Daniel Berman in *Death on the Job* states that there are still no believable estimates of the total number of those sickened, injured, or killed as a result

of industrial activity (Berman, 1978 p. 38). Fatality statistics from earlier dates are even less reliable.

In 1908, Frederick L. Hoffman of the Prudential Life Insurance Company asserted, "Thus far no national investigation of the subject of industrial accidents has been made to determine the true accident risk in industry, and the statistical data extant are more or less fragmentary and of only approximate value" (pp. 417-418). Nevertheless, he went on to imply, using evidence culled from death certificates, that the 15,000 to 17,500 accidental deaths that occurred annually among male workers were "more or less the immediate result of dangerous industries or trades."

In 1915 Hoffman upped his estimate for fatal industrial accidents. Based on statistics from the U.S. Census, the U.S. Bureau of Mines, various state reports, and the industrial experience of the Prudential Company Hoffman stated, "the probable approximate number of fatal accidents among American wage earners, including both sexes, may be conservatively estimated at 25,000 in the year 1913 and the number of injuries involving a disability of more than four weeks...at approximately 700,000" (pp. 5-6).

After 1919, Labor Department estimates of workplace deaths were based on reports by the worker's compensation system that had been created in most states. The number of deaths recorded between 1919 and 1927 ranged from 9,392 to 13,531 (Chaney, 1928).

In the late 1920s the National Safety County (NSC) took over responsibility for estimating these figures, but *Accident Facts*, the NSC's statistical handbook, gives almost no indication of where its figures came from. The reported numbers of

workplace deaths for the years 1963 through 1971 were between 14,100 and 14,500. Also, a decrease of 14% in the total number of deaths and of 45% in the rate of work accidents was reported to have occurred between 1945 and 1971 (*Accident Facts*, 1972, p. 25).

In 1974 the President of the NSC, Vincent L. Tofany, described the organization's procedure for estimation of the job accident death toll:

> NSC statisticians use the official death certificate counts made by the vital statistics authorities in HEW (currently the National Center for Health Statistics) as the source for the numbers of work, home, and motor-vehicle deaths. Within the overall total of accidental deaths, those involving motor vehicles are precisely tabulated. Such precise tabulations are not made, however, for each of the other categories (home, work, public) (p. 2).

Data from the National Center for Health Statistics is based on death certificate counts. But since death certificate counts reveal that less than half of the 1971 total of 115,000 accidental deaths are caused by motor vehicles (*Accident Facts*, 1972, p. 3), it is important to find out how the NSC divides up the rest. This is especially important given the inability of death certificates to provide accurate information. In Vital Statistics Special Reports, 53, Lillian Guralnick states,[6] "The unreliability of death certificate cause of death information is a rule-of-thumb amoung epidemiologists" (1962, no page).

President Tofany went on to further describe the NSC procedures:

> Since every nonmotor-vehicle death must be classified into one of 3 categories...this provides an effective cross-check of the separate counts. If the work count is reduced by 3,000, then this number must be added

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[6]Guralnick found, based on death certificate information, that of 34,949 accidental deaths of men age 20 to 64 with work experience, 8,297 died while at work, and 26,652 died accidents "not while at work and not stated."

> to the home and public totals. This added check, plus dozens of separate inputs, plus years of testing and refining the estimating procedures, leads the NSC to believe that its count of 14,100 work related deaths (in 1971) is very close to the true number (Tofany, 1974, p. 2).

The "dozens of separate inputs" referred to consist mostly of an incomplete and out-of-date set of state worker's compensation reports, reports from NSC members (mostly large corporations), and reports from federal agencies concerned with work accidents such as the Bureau of Mines. A spokesman from the NSC statistical department admitted that there was no standard written procedure used to compute the industrial accident death total. "It's basically guesswork," he said (Berman, 1978, p. 40).

Missouri's industrial casualty reporting system before OSHA illustrates the pitfalls of depending on workmen's compensation as a source of reliable data. Here only 115 "first-injury reports" of death (supposed to be filed by employers after a compensable injury or death occurs) were filed in 1968. Yet, projections based on the assumption of 15,000 to 115,000 job-related deaths nationally, suggest that 380 to 2,780 people were killed by work-related accidents in Missouri in 1968. This assumption is based on the NSC's estimate of around 15,000 deaths caused by work accidents and the NIOSH (National Institute of Safety and Health) estimate of 100,000 deaths cause by occupational disease. In 1968 Missouri's workers comprised 2.4% of all U.S. workers (Missouri Division of Workmen's Comp, 1969).

Since the passage of OSHA (Occupational Safety and Health Act) in 1970, there has been some change in official record keeping but the problem remains that accident reporting is left to employers, as it has always been. It is felt that massive employer underreporting is the general case throughout the nation (*Health Rights News*, 1972).

Clearly, any system based on employer self-reporting is likely to understate the extent of the problem since it is hardly in employers' interest to keep accident records which reflect badly on themselves.

A number of different approaches have been used to get more accurate information about total annual work casualties nationally, but as long as they are collected by employers they will as Berman states, "constitute a cover-up of the true incidence" (Berman, 1978, p. 49). According to Berman, every independent survey has shown that management cannot and will not register all reportable injuries. Even by NSC standards, OSHA collected figures massively understating the number of accidental deaths. Part 1904 of OSHA regulations requires that all work-related deaths be reported to OSHA within 48 hours. In 1972 only 3,000 deaths were reported by this route, so few that OSHA itself rejected the figure (Berman, 1978).

Beginning in 1972 the Bureau of Labor Statistics, in cooperation with state agencies, conducted an annual sample survey of about 280,000 to 600,000 private sector establishments. The survey was used to compile and publish information on injury, illness, and fatality statistics in the workplace. However BLS analysts and experts in the health and safety field believed that such relatively rare incidents as fatal work injuries could not be measured accurately by a sample survey. Additional studies showed that occupational fatalities were often underreported. Also, fatality estimates made by different organizations varied greatly—from 3,000 to 11,000 workplace deaths nationally per year. Differences in coverage, in definition of what constitutes a work fatality, and in estimation methodologies used by different organizations (Bureau of Labor Statistics, National Safety Council, National Institute for Occupational Safety

and Health, State and Federal worker's compensation reports) contribute to the variations. Additionally, most surveys on workplace fatalities did not generate complete or accurate information describing the incident or its circumstances.

In a 1987 report, a National Academy of Science panel "found it rather startling that an agreed upon method has not been devised to estimate a phenomena as basic as traumatic death in the workplace" (Toscano, 1991, pp. 1-2).

In response, The BLS designed the Census of Fatal Occupational Injuries as part of a broad redesign of its safety and health statistic problem. According to information from the BLS first nationwide Census of Fatal Occupational Injuries, 6,083 workers lost their lives because of injuries incurred on the job during 1992. This amounts to an average of nearly 17 workplace deaths per day (Toscano and Windau, 1993, p. 39). Of the 6,083 workplace fatalities reported by the Census, 182 of those occurred in mining—60 in coal and 83 in oil and gas extraction, leaving 39 for all other mining categories (including underground, hardrock mining), an overall rate of 27 deaths per 100,000 employed in mining activities.

If workplace fatality records for recent years are as unreliable as the above account suggests, the same type of records for even earlier times must be viewed and interpreted with extreme caution. Since there was no uniform record of mining fatalities or uniform method of recording or reporting their occurrence on the Marquette Iron Range before 1887, it is difficult to determine a reliable number of iron mining fatalities for the Marquette Range from the beginning of the underground mining period.

Lankton and Martin in "Underground Fatalities in the Upper Michigan Copper Mines" have estimated that they have uncovered 95-100% of all underground deaths that occurred between 1900 and 1924; 90-95% of all deaths occurring between 1890 and 1899; and perhaps only 60-75% of the deaths that occurred prior to 1890 (Lankton and Martin, 1987, p. 56). Post 1890 deaths were more easily documented because state legislation had set up a county mine inspector system and required counties to keep more thorough and accurate death records.

CHAPTER 6

DOCUMENTING UNDERGROUND FATALITIES ON THE MARQUETTE RANGE

Documentation of Pre-1888 Fatalities

It is very difficult to document underground mine fatalities on the Marquette Iron Range that occurred before 1888. Prior to that time there was no requirement for documentation nor was there any organization to document the fatalities that occurred in the mines. Michigan death certificates from the 1800s record very little useful information (Secretary of State, Michigan). They provide age, sex, nationality, and occupation but are not specific with respect to causes of accidental deaths, simply stating "accident" as the cause. It cannot be assumed that if a man's occupation is listed as "miner" and he died as the result of an "accident" that he died in the mine. Additionally, there are relatively few death certificates recorded that could even be interpreted as mine accidents. Most are for females or children. The number of certificates for adult males is very small, far smaller than the number of mine fatalities uncovered in newspaper accounts. Also, except in just a few cases, the names found in the newspaper and on the death certificates do not correlate. The names of men killed listed in the newspaper are not found on death certificates and vise versa, the names on death certificates are not found in the newspaper. Therefore, death certificate information was disregarded for this research.

The only record of pre-1889 fatalities that exists is death notices that appeared in the local newspapers. The *Ishpeming Iron Agitator/Ore* was found to carry the

greatest number of notices and was used as the source of fatalities from 1880 to 1889. It is certain, however, that many deaths were not recorded by death certificates or reported in the newspaper. Lankton and Martin's estimate of finding 60 to 75% of all deaths that occurred in Michigan copper mines prior to 1890 is considered to be an acceptable estimate for the Iron Range deaths that occurred before 1888. There are several factors that support this conclusion.

First, there is the fact of the extreme isolation of the entire area. Transportation and communication were very limited, there were no telephones and only a few roads. Reporters seeking news rode from location to location on horseback or bicycle, and, of course, did not visit each location every day and probably not even every week. Thus, the fatalities became "old news" before a reporter arrived.

Second, it is a well-known fact that even today there is an underreporting of workplace fatalities by employers. There is no reason to believe that employers did not try to minimize their fatal accidents before 1888.

There were several pieces of evidence found that support the validity of the assumption of underreporting of fatal accidents in the iron mines by employers and in the newspaper before 1888.

Although not pertaining to iron mining fatalities, the following description of the Sault Locks cholera epidemic illustrates how and why fatalities were concealed.

At the time of the construction of the Sault Locks the first reports of isolated cases of cholera appeared in the middle of June 1854. At this time, builders of the canal were frantically trying to recruit additional workers to complete the year's work before winter set in and by August more than 150 additional men had been transported

from the east—New York, Montreal, Vermont—to the Sault. Passing through Detroit, where cholera was rampant, several of the new recruits contracted the disease and carried it to the Sault where filthy living conditions in the construction camps made the area ripe for disaster. The first case in August was covered up by reporting the stricken man as "a miserable drunkard (Dickinson, 1981, p. 79), and for almost a month no more was said. Publishing the full extent of the epidemic as it developed would have made it impossible to recruit new workers and would have seriously jeopardized the project. Finally, in October 1854 the total number of deaths at the Sault was reported for the previous 14 months without listing any of the causes—8 strangers passing through the Village, 12 citizens of the Sault, and 88 canal workers (Dickinson, 1981, p. 80).

Today far more than 88 are known to have died in the epidemic. The exact number is unknown but it is estimated that of the entire force of 1,700 men well over 170 may have died (Dickinson, 1981, p. 80). It is reported that many of the dead were hastily buried at night, unknown to the other workmen, to prevent a mass exodus of workers from the Sault (Hatcher, 1950, p. 78). Covering up the disease was believed to be essential to the success of the canal project, which was continuously plagued with problems.

The cholera epidemic spurred a new effort to recruit men to replace the sick and dead. Perhaps a better estimate of the actual number of fatalities may lie in information which reveals that between September 7 to 30, 1854, 472 men from Albany left for the Sault (Dickinson, 1981, p. 80).

A similar, but much smaller scale, occurrence nearly 30 years later during the construction of the Huron Bay Road in Marquette County was reported to the *Ishpeming Iron Agitator/Ore*. Three laborers were reported to have died of typhoid fever. However, a laborer who had worked on the road later told the Ishpeming newspaper that "several deaths had occurred in the camps and for want of better accommodations the men were buried on the spot without any ceremony whatever" (*Ishpeming Iron Ore*, 1884).

In addition to concealment of information by employers, a 1911 paper given before the LSMI by Charles S. Hurter, a technical representative of the E. I. DuPont De Nemours Powder Company, on accidents in the use of explosives illustrates the paucity of official data pertaining to U.S. industrial accidents as well as the difficulty encountered in gleaning it from newspaper accounts.

> The British government has kept detailed records of all accidents in the manufacture, storage, transportation, and use of explosives since 1875.

However, he continued,

> In this country the E. I. DuPont de Nemours Powder Company has, for six years, made a systematic collection of newspaper clippings relating to accidents with explosives and it is from these that the writer has to obtain his data. This is not a very accurate source of information as compared with the English reports but it is the best obtainable in the U.S. up to the present time...While the larger accidents invariably get into the newspapers...many of the smaller and possibly more instructive ones get no notice whatsoever. Those accounts taken from the English reports are...an accurate compilation by government officials of the details of every accident with explosives in the U.K. On the other hand the records of the accidents in the U.S. are obtained solely from newspaper clippings from various clipping bureaus. As everyone knows, newspaper accounts are often not entirely accurate... (Hurter, 1911, pp. 177-179).

If the mining fatalities taken from the *Ishpeming Iron Agitator/Ore* even represent 75% of the deaths that occurred during the period for which the newspaper was the only source of data then 61 deaths remain unaccounted for. The total number of deaths for that period should then be 244 instead of 183. In compiling the fatality data for this research, four years of data were taken from both the *Ishpeming Iron Agitator/Ore* and the County Mine Inspector Reports. For these four years, 1889-1892, it was found that 49.5% of the fatalities reported by the Mine Inspector were found in the newspapers. This would mean that 187 deaths were not accounted for and a total of 370 deaths occurred between 1879 and 1889. If 1889 to 1892 serves as a window into the preceding decade, then the average fatality rate may have been as high or a little higher than it was in the 1890 to 1899 decade.

Before 1888 little in the way of labor statistics of any type, not only that pertaining to fatalities, was known about the mining industry of the Upper Peninsula because it was so far removed from state agencies located in Lansing that collected, compiled and reported such information. The 15th Annual Report of the Bureau of Labor and Industrial Statistics, 1898, supports the conclusions drawn with regard to fatalities and employment statistics:

> In looking over the situation and studying the condition of the laborers and wage earners of the State, in preparation for our annual report, we discovered that little was known and that nothing reliable could be stated pertaining to the thousands of toilers in our mines of the upper peninsula.
>
> We possessed a general knowledge that there was a State Commissioner of Mineral Statistics, ..., and a number of local inspectors of mines..., and we had presumed that these officials investigated matters of labor and wages and reported them in some manner. After a careful study of the laws creating these offices and defining the duties of both mineral statistician and mine inspector, we find that no such

> provisions are made and that there is nothing requiring a canvass, investigation, or report upon the wages, number of men or general labor statistics of the large number of miners employed in the State.
>
> ...We felt that we could be neglecting our sworn duty if we failed to investigate and obtain reliable statistics from the mines, which rank with the largest and most important industries of this State...We appointed the Hon. George Wagner of Marquette, Special Canvasser, with full authority to visit and investigate the general condition of the various mines and collect statistics as to wages, matters of employment, the necessity of safety appliances, accidents, ... (Wagner, 1898, pp. 277-278).

Documentation of Post-1888 Fatalities

The office of County Mine Inspector was established in 1887 (Michigan Public Acts, 1887, pp. 252-254) and it was part of the inspector's described duty to publish an annual report in which the number of causes of all fatal accidents were described. As the reports evolved, they began to include more detailed information especially with respect to general employment statistics, such as number employed, hours worked and mines in operation.

Although the Report of 1888 is missing, the fatality data after that time is much more complete. The weakness of the Mine Inspector Reports is that the Inspector could only report on those fatal accidents that were brought to his attention. There was no way for the mine inspector to know of these accidents unless he was notified by the mine captain or perhaps the miners themselves. If there were accidents other than those reported to him, they remained unknown. Originally, there was no requirement in the law that fatal accidents had to be reported to the mine inspector (Michigan Public Acts, 1887, Section 8).

Selection of a Method for Comparison of Fatalities Over Time

In order to make a meaningful comparison of the fatal mine accidents over time, the raw fatality numbers must be compared on the same basis, that is, a fatality rate must be established. The best basis for comparison is a fatal accident rate based on the number of man-hours exposure. This takes into account, not only the number of men employed, but also the length of the working day. It provides a value for the total exposure of the men employed to the hazards that existed at a given time. Exposure rate is often expressed in terms of 1,000 300-day workers, per 1 million man-hours or, peculiar to the iron mining industry, in terms of man-shifts worked (number of men x number of shifts worked).

In an attempt to produce comparable fatality and accident statistics on a nationwide basis, the U.S. Bureau of Mines developed standardized forms for accident reporting in 1916, requesting rates to be calculated on the basis of 1,000 300-day workers or millions of man-hours. Nothing immediate came of these efforts. Beginning in 1921 the number of 300-day workers were included in some annual reports of the County Mine Inspector but not in all of them. Then in 1931 man-shifts worked were reported along with the total number of employees and the number of days each mine worked. Although man-shifts is an exposure rate, it does not comply with the Bureau of Mines requirement. The number of fatalities per 1,000 300-day workers cannot be calculated from the data provided in the Mine Inspector Reports. It was not until 1921 that the Mine Inspector Reports clearly reported the number of fatalities per 1,000 300-day workers.

Because for so much of the period covered by this research that was no data available from which to calculate an exposure rate, the number of fatalities per 1,000 workers (a fatality rate) was used as the basis for comparison. It represents the only data that can be compared across the entire time period studied and it does provide a measure of the level of risk assumed by workers at a given time. Unfortunately, a fatality rate cannot be established for the first decade of the study because employment statistics were not available.

A fatality rate based on production was also calculated. However, a complete record of mine production does not exist for the period of the study either. From 1880 to 1922 only ore shipments were recorded. Only after 1922 could production data for each mine be obtained. Addressing the LSMI in 1900, President William Kelly lamented this data problem:

> It is to be regretted that no record of the yearly output of the various mines is available. It would show unmistakably to what extent the reduction of cost had been due to increased production. In some years shipments are considerably less than the output and in others correspondingly exceed it,... (Kelly, 1900, pp. 15, 17).

These data shortcomings were also noted by Davis in his dissertation entitled "Demographic Changes and Resource Use In The Western Counties of Michigan's Upper Peninsula, 1860-1950;

> In spite of the shortcomings of shipment data as a measure of the region's mining activity, it has been used throughout this chapter as it was the only type with which it was possible to compile a complete annual list of comparable data (Davis, 1961, p. 144).

Because averaged over time ore shipments equal production, the use of this data should not interfere with general deductions as to the amount of ore produced per

fatality. Also, increases in the amount of ore produced per fatality more accurately reflect improvements in mining technology than they do improvements that would have reduced the number of fatal accidents.

Because the mines operated only part of the year in the early days of mining, the exposure of the miners to the hazards of the job was less than when the mines worked nearly the entire year in the later years. In the early decades of mining, the mines were closed periodically for reasons related to the economy, the season of the year and the physical condition of the mine more frequently and for longer periods of time than they were in later decades. Thus, in the early years of mining, the large number of deaths per 1,000 employees becomes even more significant because these deaths occurred at a lower exposure rate. Likewise, the lower number of deaths per 1,000 employees in the later years is significant because of the relatively higher exposure of the miners to the existing dangers. This lower fatality rate at a higher exposure indicates the existence of factors that reduced the hazards of mining and thus made the mines safer places in which to work.

Statistics concerning the iron mining industry on the Marquette Range have been compiled in many different ways, making figures on employment, production, and fatal accidents highly inconsistent and therefore very difficult to interpret. That this has always been a problem is indicated by a paper given at the 1923 Lake Superior Mine Safety Conference by George Martinson. Martinson, the Range Safety Inspector for Pickands-Mather Company and Chairman of the Lake Superior Mine Safety Conference, in attempting to illustrate the improvement in accident records that had

been made over the past decade as a result of operator attention to safety, made this statement:

> Due to the many different methods pursued by the various mine operators and public officials in compiling accident statistics, it is almost impossible to compile a set of figures which would indicate the improvement that has been made (LSMI, 1923, p. 64).

Given the difficulties encountered in data acquisition, it was possible to compile a data set that covered nearly all of the 100-year time period chosen. Table 4 is a compilation of all of the underground fatalities taken from the *Ishpeming Iron Agitator/Ore* and the Mine Inspector Reports, underground employment figures, and ore production or shipments. From this data a death rate (deaths per 1,000 employed) and the number of tons of ore mined per fatality has been calculated. This data is also presented in graphic form in Figures 2, 3, and 4.

Table 4. **Marquette Iron Range Data: Annual Fatalities, Employment, and Production; 1880-1979.**

Date	Deaths			Ore Produced (long tons)	Employment		Tons/ Death	Deaths Per Thousand
	Ratios	Paper	Inspector					
1880		21		1,243,671	N.A.		69,222	N.A.
1881		21		1,445,882	N.A.		68,852	N.A.
1882		23		1,701,091	N.A.		73,960	N.A.
1883		10		1,191,441	N.A.		119,144	N.A.
1884		21		1,451,935	N.A.		69,140	N.A.
1885		20		1,344,639	N.A.		67,232	N.A.
1886		22		1,506,129	N.A.		68,460	N.A.
1887		25		1,751,803	N.A.		70,072	N.A.
1888		20		1,762,754	N.A.		88,138	N.A.
1889	[75]	24	28	2,503,708	6,750	BY RATIOS	89,418	4.14
1890		8	45	2,869,472	8,250		63,766	5.45
1891	24	15	27	2,447,178	6,000		91,747	3.50
1892	27	10	26	2,544,336	5,423		97,861	4.79
1893	18	N.A.	18	1,767,432	3,872		98,191	4.65
1894	13	N.A.	12	2,027,972	2,629		168,498	4.56
1895	N.A.	N.A.	11	2,049,056	2,680		186,278	4.10
1896	N.A.	N.A.	25	2,522,423	3,487		100,897	7.19
1897	N.A.	N.A.	14	2,643,118	3,114		188,794	4.50
1898	N.A.	N.A.	17	3,020,316	3,291		177,666	5.17
1899	N.A.	N.A.	22	3,608,365	4,241		164,017	5.19
1900	N.A.	N.A.	24	3,277,088	4,970		136,545	4.83
1901	N.A.	N.A.	29	3,081,305	3,900		106,252	7.43
1902	N.A.	N.A.	27	3,624,706	4,133		134,248	6.52
1903	N.A.	N.A.	20	2,760,372	4,500		138,019	4.44

Date	Deaths				Ore Produced (long tons)	Employ-ment	Tons/ Death	Deaths Per Thousand
	Ratios	Paper	Inspector					
1904	N.A.	N.A.	15		2,673,266	3,018	178,218	4.97
1905	N.A.	N.A.	20		3,928,881	3,795	196,443	5.27
1906	N.A.	N.A.	20		3,840,372	4,380	192,019	4.57
1907	N.A.	N.A.	37		3,699,215	5,058	99,978	7.32
1908	N.A.	N.A.	16		2,234,366	4,021	139,960	3.98
1909	N.A.	N.A.	23		3,904,522	4,261	169,762	5.40
1910	N.A.	N.A.	27		4,106,478	4,909	152,092	5.50
1911	N.A.	N.A.	31		2,923,015	4,788	94,291	6.47
1912	N.A.	N.A.	14		3,724,440	3,469	266,035	3.53
1913 U	N.A.	N.A.	14		3,216,735	3,895	229,767	3.59
1914	N.A.	N.A.	19		2,119,718	3,256	111,564	5.83
1915	N.A.	N.A.	9		3,340,304	2,524	376,689	3.56
1916	N.A.	N.A.	11		4,327,654	3,332	393,423	3.30
1917	N.A.	N.A.	13		4,228,288	3,656	325,253	3.56
1918	N.A.	N.A.	11		3,831,610	3,103	348,324	3.54
1919	N.A.	N.A.	10		2,667,203	3,266	266,720	3.06
1920	N.A.	N.A.	8	S	4,102,770	3,088	512,847	2.59
1921	N.A.	N.A.	4	▲	871,291	2,896	217,811	1.38
1922	N.A.	N.A.	1	┼	2,373,971	1,433	2,373,971	.69
1923	N.A.	N.A.	8	▼ M	3,493,698	2,357	436,713	3.39
1924	N.A.	N.A.	5		4,367,453	2,236	873,591	2.24
1925	N.A.	N.A.	1		3,462,492	2,182	3,462,492	.46
1926	N.A.	N.A.	3		3,341,427	2,003	1,113,809	1.50
1927	N.A.	N.A.	2		3,136,368	2,182	1,586,184	.92
1928	N.A.	N.A.	3		2,929,544	1,977	976,531	1.52
1929	N.A.	N.A.	4		3,318,316	1,664	829,579	2.40

Date	Deaths			Ore Produced (long tons)	Employ-ment	Tons/ Death	Deaths Per Thousand
	Ratios	Paper	Inspector				
1930	N.A.	N.A.	9	3,714,698	1,584	412,744	5.68
1931	N.A.	N.A.	4	2,347,687	1,603	586,922	2.50
1932	N.A.	N.A.	0	642,485	1,208	--	0
1933	N.A.	N.A.	0	750,085	1,211	--	0
1934	N.A.	N.A.	3	1,904,134	1,513	634,711	1.98
1935	N.A.	N.A.	2	2,431,359	1,578	1,215,680	1.27
1936	N.A.	N.A.	1	3,678,383	1,802	3,673,383	.55
1937	N.A.	N.A.	2	4,573,492	2,193	2,286,741	.91
1938	N.A.	N.A.	2	2,372,620	1,938	1,186,310	1.03
1939	N.A.	N.A.	3	3,303,663	1,945	1,101,221	1.34
1940	N.A.	N.A.	2	4,544,493	2,131	2,272,247	.97
1941	N.A.	N.A.	4	5,277,486	2,553	1,319,372	1.57
1942	N.A.	N.A.	9	5,692,542	2,756	632,505	3.27
1943	N.A.	N.A.	5	5,121,981	2,789	1,024,396	1.79
1944	N.A.	N.A.	2	4,226,865	2,325	2,113,433	.86
1945	N.A.	N.A.	1	4,140,568	2,070	4,140,568	.48
1946	N.A.	N.A.	0	3,155,457	2,206	--	0
1947	N.A.	N.A.	8	4,532,094	2,149	566,512	3.72
1948	N.A.	N.A.	6	4,525,356	2,124	754,226	2.82
1949	N.A.	N.A.	2	4,065,235	2,267	2,032,618	.88
1950	N.A.	N.A.	3	4,639,276	2,355	1,546,425	1.27
1951	N.A.	N.A.	2	5,125,240	2,575	2,562,620	.78
1952	N.A.	N.A.	4	4,357,513	2,495	1,094,393	1.60
1953	N.A.	N.A.	2	5,111,944	2,591	2,555,972	.77
1954	N.A.	N.A.	1	4,238,312	2,410	4,238,312	.41
1955	N.A.	N.A.	3	4,678,581	2,197	1,559,527	1.37

Date	Deaths			Ore Produced (long tons)	Employ-ment	Tons/ Death	Deaths Per Thousand
	Ratios	Paper	Inspector				
1956	N.A.	N.A.	1	5,341,643	2,514	5,341,643	.39
1957	N.A.	N.A.	3	5,662,922	2,382	1,887,641	1.26
1958	N.A.	N.A.	4	3,345,755	1,779	836,439	2.25
1959	N.A.	N.A.	1	2,742,568	1,490	2,742,568	.67
1960	N.A.	N.A.	2	4,463,855	1,605	2,231,928	1.25
1961	N.A.	N.A.	1	2,817,450	1,109	2,817,450	.90
1962	N.A.	N.A.	0	2,587,899	941	--	0
1963	N.A.	N.A.	0	2,198,636	774	--	0
1964	N.A.	N.A.	0	1,816,427	738	--	0
1965	N.A.	N.A.	0	2,828,527	875	--	0
1966	N.A.	N.A.	1	2,615,086	1,018	2,615,086	.98
1967	N.A.	N.A.	5	2,917,000	1,008	583,400	4.96
1968	N.A.	N.A.	0	2,863,000	807	--	0
1969	N.A.	N.A.	0	2,708,000	808	--	0
1970	N.A.	N.A.	1	2,465,617	829	2,965,617	1.21
1971	N.A.	N.A.	0	2,377,123	661	--	0
1972	N.A.	N.A.	0	2,230,050	570	--	0
1973	N.A.	N.A.	0	1,958,657	525	--	0
1974	N.A.	N.A.	0	1,839,412	582	--	0
1975	N.A.	N.A.	0	1,746,678	513	--	0
1976	N.A.	N.A.	1	1,671,384	521	1,671,384	1.92
1977	N.A.	N.A.	0	1,194,071	518	--	0
1978	N.A.	N.A.	0	1,803,957	495	--	0
1979	N.A.	N.A.	0	1,012,558	310	--	0

U - Underground Data Available S - Shipped M - Mined

Figure 2. Number of Deaths per Year in the Underground Mines on the Marquette Iron Range: 1880 - 1979.

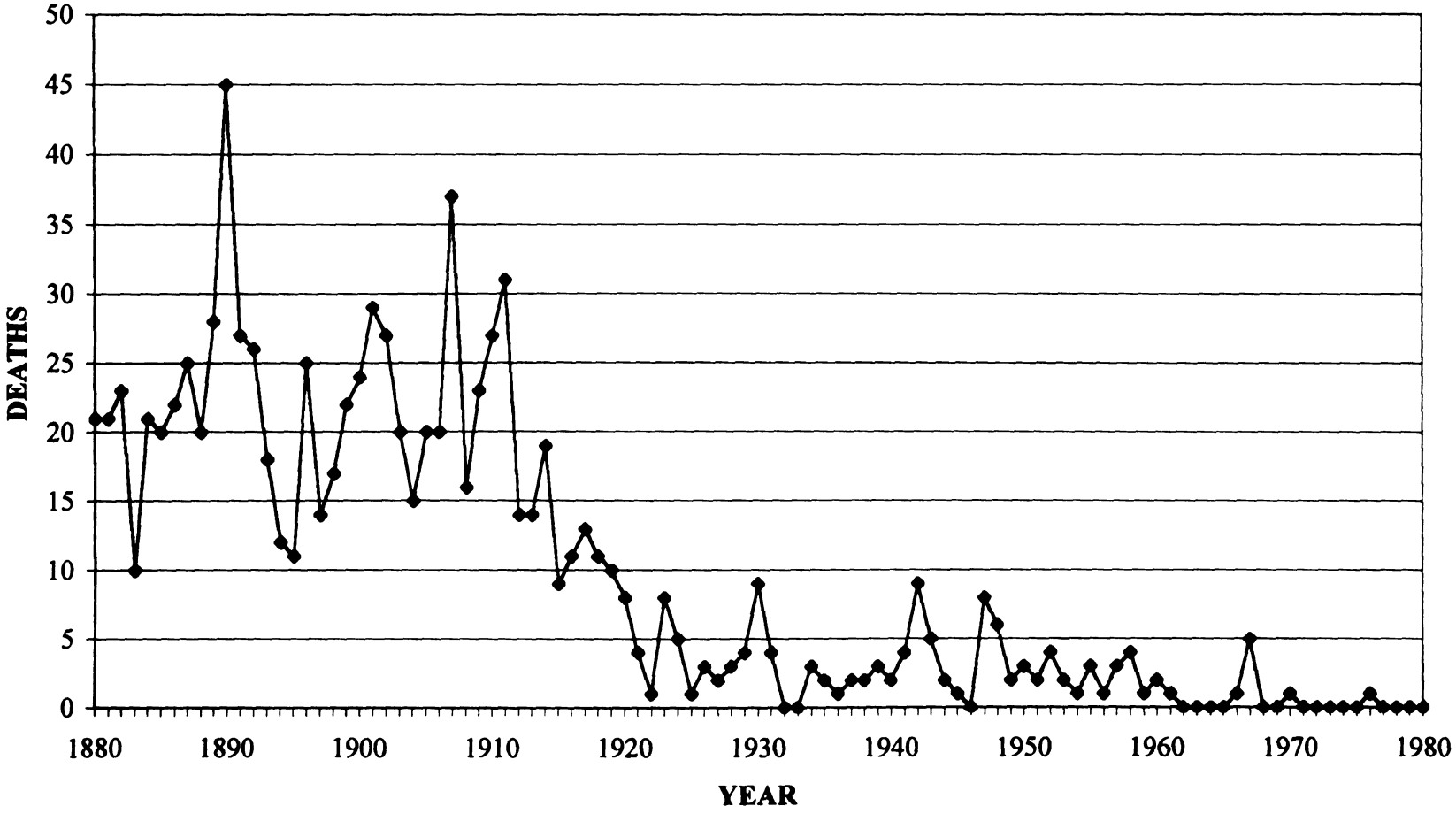


Figure 3. Fatality Rate (Fatalities per 1000 Employed) per Year in the Underground Iron Ore Mines on the Marquette Iron Range: 1888 - 1979.

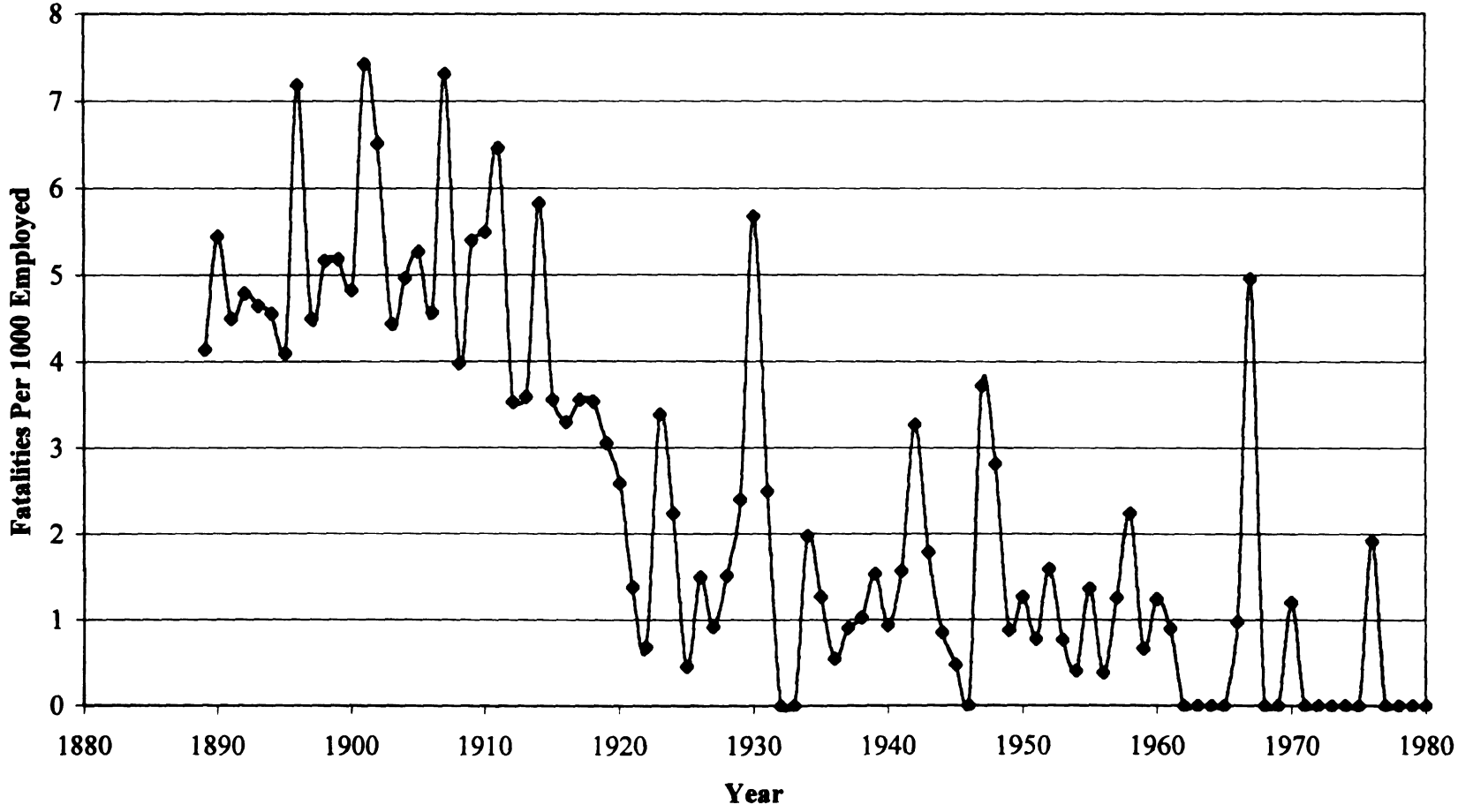
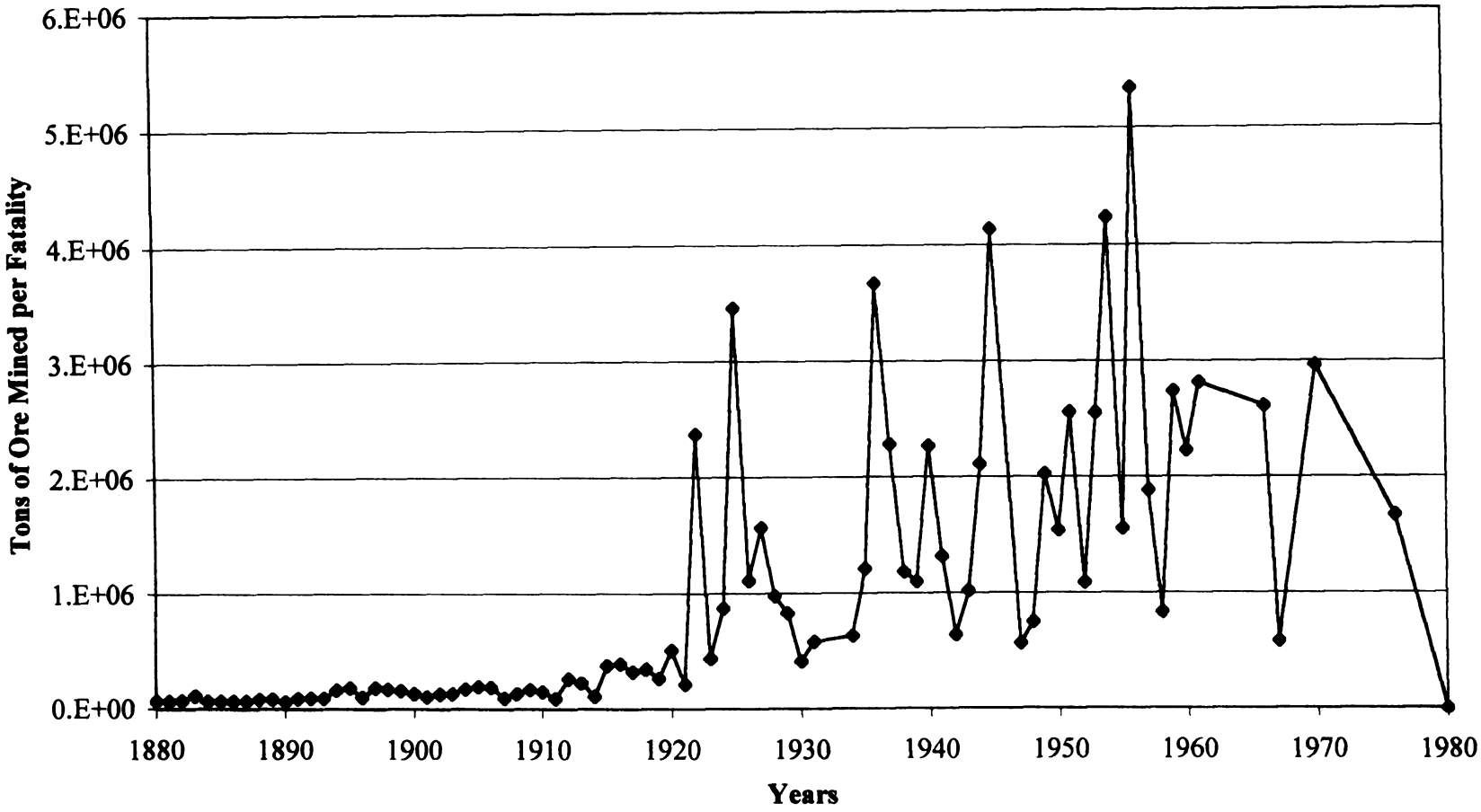


Figure 4. Tons of Ore Mined per Fatality per Year in the Underground Iron Ore Mines on the Marquette Iron Range: 1880 - 1979.



CHAPTER 7

ANALYSIS OF FACTORS CONTRIBUTING TO AND INDICATIVE OF THE ACCEPTABILITY OF FATAL MINE ACCIDENTS ON THE MARQUETTE IRON RANGE

Introduction

In order to meet the second objective of the research, it is necessary to have some knowledge of the region and the industry in which the fatal accidents occurred. Chapters 3 and 4 provided some broad introductory material. Chapter 7 provides material that gives a better understanding of the men involved in mining the iron ore, how they lived, and the conditions of their work. It will explain why men were willing to live in a primitive, isolated area and work in mines that were admittedly dangerous. It will also explain why little attention was given to the fatal accidents that occurred in the early mining days.

Attitudes toward life and death are difficult to assess more than 100 years after the fact and conclusions drawn are necessarily interpretive. The best documentation remains quotes from individuals involved. This chapter relies on quotes from the following sources; the mine workers themselves, which are few; the local newspaper, the *Ishpeming Iron Agitator/Ore* should serve as a window into the thoughts and lives of people in the area. However, as will be show, the paper was influenced at least to some degree by the mining industry; the Proceedings of the LSMI, a professional meeting of mining men from the Lake Superior region. This meeting was attended by all levels of management from presidents of companies through managers to foremen. As such, the proceedings from the Institute provide a good window into the thoughts of

these men as they presented their concerns in a relatively private atmosphere; the Bureau of Labor, a state organization concerned with employees and conditions of employment in industries throughout the state.

Influence of Living and Working Conditions on Reactions to Fatal Accidents

Histories of mining communities throughout the United States generally include a discussion of the large number of foreign-born who came to work in the mines. In such places as Butte, Montana; Cherry Creek, Colorado; and Silver City, Nevada, the foreign-born comprised from one-third to one-half of the total population. The Marquette Iron Range was unique in that immigrants made up an even larger percentage of the population. According to the Census of 1870, 71% of the population of Ishpeming township was foreign-born, with smaller proportions found in the other townships: Chocolay (63%), Negaunee (55%) and Marquette (53%) (Alanen, 1991, p. 5). By 1909 the population consisted of 47.2% foreign-born and 40.5% native-born of foreign parents (Moulton, 1909, p. 86).

By the end of the 19th and into the early 20th centuries, the Marquette Range iron mining companies had employed thousands of immigrants in dirty and dangerous jobs. Although tremendous advantage was taken of their labor, the men and their families were seemingly content. Why was this true?

In the 19th century, little working-class consciousness existed in communities subdivided into various ethnic elements. Since the 1840s the country had counted on immigrants to dig canals, lay railroad tracks, build cities, fill the ranks of unskilled factory workers, and mine the metal ores essential to the growing economy. Much of the first wave of immigration came from the industrial districts of northern Europe, and

with them they brought skills crucial for the developing industrial economy. They served as the teachers of American labor and had a shaping influence on working-class culture and institutions. But during the latter part of the century, northern immigration was supplanted by a high number of lower-class immigrants from southern and eastern Europe. This new wave almost wholly lacked industrial skills and became the low paid, bottom ranks of workers that constituted a windfall to American industry. Neither wage rates, working conditions, nor living standards figured crucially in these immigrants' calculations, but rather the job itself. Faced with decline into the dependent, propertyless, servant class as the village subsistence economy of their own countries was undermined, a few years of hardship seemed a cheap price to pay for savings with which they could return home. "America," a Polish worker wrote home, "is a golden land as long as there is work, but when there is none the country is worth nothing" (Brody, 1993, p. 17). Difficult and dangerous working conditions meant little to these immigrants. Their hardships were part of the bargain.

Quotes from the Iron Country affirm the unimportance of existing conditions to the immigrant. An old man related the following:

> I came to this country from Bulgaria in 1913, I came here with the intention to stay for a couple of years and if I made $200 I could go back there by the village. The money was different, I'd be a rich man. I started digging ditches at the mine. It was hard, I didn't know English (Bernhardt, 1975, no pagination).

Another echoed similar sentiments;

> I came to this country to get a job, to earn money...When I came to this country I never figured to stay. If I had the money, I would have gone right back (Bernhardt, 1975).

Asked about discontent among the immigrants, he continued;

> No, you didn't hear a lot of discontent about working conditions in the mines. I think these immigrants came here and maybe they didn't find gold in the streets, but at least they had a job. The standard of living was much improved from what they had in the foreign country (Bernhardt, 1975).

The living conditions for the men and their families were much better on the Marquette Range than in other mining regions. There were no smelters, as in Butte, Montana, to poison the air with thick smogs of sulfur, arsenic and other heavy metals. And although the red dust from the ore created its share of problems, the area was not dreary and blackened with coal dust and smoke as were the coal-mining towns of the east. The air was fresh and clean and the pure water of Lake Superior provided a source of fish and recreation as well as transportation.

Additionally, the working population was not robbed of their hard-earned income by the company store system that existed in the eastern coal and western mining regions. A wide variety of goods and services were provided by independent merchants who were attracted to the growing area.

It was not a romantic writer for a tourist agency, but the Michigan Commissioner of Mineral Statistics who wrote in his 1877-78 report:

> The City (Marquette) abounds in evidence of prosperity, intelligence and cultivated taste. It's large and elegant high school building constructed of handsome brownstone from the quarries in the city, roofed with the dark blue slate from Huron Bay; it's fine church edifices, hotels, business blocks, and private dwellings,...it's clean, well-paved and shaded streets, the pure water drawn from the cool depths of Lake Superior; the streets and dwellings lighted with gas; the ample facilities for transportation and communication, afforded by railway, lines of steamboats, vessels and telegraph, place it among the most favored cities...(Hatcher, 1950, pp. 121-122).

On the Iron Range itself, Ishpeming had become the largest town in the Upper Peninsula. It was the business center for the largest mines. It had a new school building, large blocks of stores, and foundries and machine shops. It boasted the best hotel in the region and the most attractive dwellings in the mining district. The enormous demand for ore had transformed the region from one of the most remote frontiers to that of a thriving business center.

Extremely important to the type of long-term mining venture unfolding was a skilled and stable workforce. This necessitated finding and keeping experienced men to work the mines. Finding them was one thing, because immigrants flocked to the area, but keeping them in the remote region was another. The companies found it both advantageous and necessary to provide amenities for the miner and his family, as well as good wages, to help offset the rigorous nature of life and work in the iron region.

As the area grew, extensive paternalism developed in which the mining companies became not only landlords, building and maintaining housing, but also providers of medical care, and a variety of social and public services. The companies were noteworthy for their fairness and there was little conflict between labor and management.

"There is something interesting about this mine community at the time before the union." An old woman related,

> They paid small wages but they also provided you with a house, very cheap rent—for instance, our house had four rooms down and four rooms up, and was five dollars a month rent. There was a big garden around it already fenced. We paid a dollar for our lights, a dollar for the water, and a dollar for the doctor. Eight dollars a month was all it cost us for all of them. They call it paternalism now, the unions call it paternalism. But to us, we are quite satisfied with it (Bernhardt, 1975).

In the late 19th century the *Iron Agitator/Ore* wrote proudly of the living conditions, the exceptions being encouraged to change and Charles Lawton, in *The Michigan Miner*, noted the good relationship between companies and men. Many pieces of evidence were found in the literature that support the claim that the men were generally satisfied with the conditions under which they lived and worked on the Marquette Range. A few examples are quoted below, and more can be found in the Appendix.

> Several boys are going to Leadville, they think to acquire fortunes. But, if the boys will only consider the real difference between the Leadville country and this iron center they will see a more vast opportunity for the workingman to live happier and better here (*Ishpeming Iron Agitator/Ore*, January 2, 1882).
>
> All houses belonging to the Humbolt Iron Company are being shingled and undergoing other repairs. It is an improvement in our appearance (*Ishpeming Iron Agitator/Ore*, July 29, 1882).
>
> Dust is terrible when the wind blows...dust don't (sic) add to our attraction as a summer resort and it ought to be quieted in every possible way (*Ishpeming Iron Agitator/Ore*, June 9, 1888).
>
> When the mine whistle blows it means that our mines are in operation, our miners employed, the town prosperous. It means just what it says "business" (*Ishpeming Iron Agitator/Ore*, October 13, 1888).
>
> Are putting quartzite on the roads in Ishpeming...this will make the best roads in the area (*Ishpeming Iron Agitator/Ore*, October 19, 1889).
>
> A new mine hospital is planned by Cleveland Iron Mining Company and Pittsburgh-Lake Angeline Iron Company. It will be brick, heated by steam and have incandescent lights (*Ishpeming Iron Agitator/Ore*, November 7, 1891).
>
> At American Mine the Health Officer has given some residents 24 hours to clean up the filth around their homes and the road in front (*Ishpeming Iron Agitator/Ore*, July 23, 1892).

> As a rule there is a good degree of confidence and right feeling prevailing between the employees and the employers in our Lake Superior Mines. In no other section of the country, I opine, where the laboring population so greatly predominates, is there less discontent or complaint. The miners are in a position of independence. They are reasonably sure of fair treatment and of good wages (Lawton, 1903, p. 11).

Even though the living conditions were considered to be much better on the Marquette Range than those existing in other United States mining regions or in the countries the immigrants left, the working conditions in the mines were nevertheless dangerous and difficult. Temperatures in the mines were generally warm and men worked coated with the red iron ore dust which was particularly bad after the introduction of power drills. They also often worked soaking wet. Initially, sanitary conditions in the mines were primitive, waste from mules and men fouled the air, and rats made the mine tunnels their homes. Both the red dust and the mine sanitary conditions may have affected the health of the miners but little has been written about health effects. Typhoid fever often plagued the area and is a disease now known to be related to unsanitary conditions. However, the mines were not exceedingly hot and the importance of good ventilation was recognized very early as the mines moved underground. This was not the case in most western underground mines. In mines on the Comstock Lode, for example, underground temperatures commonly reached 105 to 110 degrees. These western mines were also plagued with large amounts of scalding hot water that would unexpectedly be released and cascade down upon the miners. Also, drilling the quartz-rich rock in many western mines resulted in rampant silicosis. In the coal mines, black lung disease reached epidemic proportions.

The following excerpts, in the words of the Michigan iron country miners, are given as examples of the working conditions they endured and why they stayed (see Appendix for additional quotes):

> Remember when they used to go up in the raises without hard hats: I used to have a powder box so it fit on top of my head and covered my ears. I'd wear that box on top of my head in case a chunk came and hit. You had to climb up this chimney way, the raise. You'd be maybe one hundred feet up on poles. Then they give you a machine to drill with. You'd balance on one plank across this chimney way and you'd balance the machine on another. The machine would be pounding and dust would be falling all over. You couldn't breathe because it was a gas hole. Most of the time you wouldn't even use a ladder to climb up, you'd climb up those stage poles like a monkey (Bernhardt, 1975, no pagination).

> The company wouldn't put fathers and sons working together, because if something happen, both get killed. But if he work with somebody else, maybe I get killed, but my son is saved (Bernhardt, 1975, no pagination).

> ...the only way out was the mine shaft, which is literally a vertical hole more than two thousand feet straight up and the row of muddy and wet ladders within it for climbing. Many times, I thought of running away but, as I will repeat, the fear of running into something worse, like unemployment, kept me coming back. Besides, it didn't do any good to dwell in morbid thoughts. In those circumstances, work was the best available antidote to depression (Etelamaki, 1998, p. 85).

> After drilling and blasting, then of all the problems a miner had to cope with, the worse was the lingering noxious gas created by exploding dynamite...When the lungs were soaked with those fumes, it was a sure fire way to bring on the mother of all headaches. There was no escaping that acrid stench. It clung to the work clothes. At times, the head pain was so severe, I could actually hear blood coursing through my carotid arteries (Etelamaki, 1998, pp. 92-93).

> Why didn't I leave here? To tell the truth, I was living a little bit in fear. I couldn't speak the language very good, I got married and had four kids. With the family, where could I go if I lost my job? I ain't got the education. What could I start doing? I was afraid (Bernhardt, 1975, no pagination).

> Although this is a small city (Negaunee, Michigan) here are 16 mines...rare is the day that someone is not hurt in my time here several men have died in the mines. I have worked in the mines for three months and I know the work and well what it is like (Penti-Vidutes, 1978, p. 26).

Newspaper Fatality Reporting as a Way to Assess Attitudes About Death in the Mines

Relatively good wages, living conditions and working conditions kept the miners content. They were able to accept the dangers of their job as a matter of fact as long as the other factors were satisfactory. Also, in the late 19th and early 20th centuries death, not only in the workplace, but everywhere was not uncommon. A few deaths more or less didn't draw much attention.

In 1891 the following deaths were reported by the *Ishpeming Iron Agitator/Ore*:

August 1—several deaths due to pleuro-pneumonia, also whooping cough and brain fever; August 15—four infants died of summer complaint; August 29, September 5—nine more infants died; September 19—one death each from croup, typhoid, pneumonia, and a shooting; October 10—four typhoid deaths, two infants died; October 31—one man died when stepped on by a horse, one consumption, one stroke, and one typhoid, a young boy was killed by railroad cars while playing; November 7—three typhoid deaths; November 14—a sewer worker carrying bricks across the railroad tracks was killed by a train, five typhoid deaths; January 2—a ten year old was killed when run over by a team, a train accident killed two, a man died of a cut wrist while wiping glasses in a saloon.

In 1888 the *Ishpeming Iron Agitator/Ore* published a record of deaths provided by the City Assessor (June 8, 1888). The total number of deaths was 192 and was comprised of the following:

> 18 men who were killed by various causes (including mining but not listed separately as a cause of death) and ranged in age from 30 to 55; 90 infants less than one year old; 12 people who died of consumption, 10 of bronchitis, one of typhoid, nine of heart disease, five of diphtheria; 21 people between the ages of 50 to 85 died of "old age"; additionally there were two suicides, one drowning, and one burned.

It is easy to understand how one or two workplace deaths in the mines every now and then failed to stir much interest or concern. The deaths in the mines were simply reported without comment along with news of other fatalities. The following excerpts were found in the *Ishpeming Iron Agitator/Ore* in the same columns, in the same type style, with nothing to distinguish one from the other in terms of importance. Many of these short notices can be found. A few are given in the test as examples, more can be found in the Appendix.

> An unnamed miner died of a fractured skull caused by falling rock at Saginaw Mine (January 10, 1880).

> Burt Vaugh, aged 18, reached for the bell rope and feel 65 feet down the shaft at Michigamme Mine. He was killed (January 31, 1880).

> Erick Erickson was killed by a blast at the Cleveland Mine (January 1, 1881).

> 35 deaths due to sunstroke in Cincinnati on Wednesday; and Wm. Snell, aged 36, was killed when crushed by a falling rock he was barring down at Jackson Mine. Careless as he disobeyed orders (July 16, 1881).

> A streetcar brawl in Negaunee killed one miner (April 1, 1882).

> The Vulcan, Norway, and other mines near Norway of the Cambria Iron and Steel Company will be partially closed due to the destruction of the plant by the Johnstown flood 10 day ago. (author's note: over 2,000 people were estimated to have died in this flood) (June 8, 1889).

31 deaths from typhoid in Ishpeming last year (January 16, 1892).

A miner was killed today, probably electrocuted. Another died in a blast; and A streetcar ran over a dog Tuesday killing the animal instantly (March 2, 1902).

Although in 1883 (*Ishpeming Iron Agitator/Ore*, October 14, 1883) one report by the newspaper called an accident "shocking"—"Two men and two boys (16 and 14) met instant death in a "shocking accident" at the Republic Mine..."—There is no indication that these Iron Range mining fatalities raised any special concerns. They, in fact, involved far fewer individuals than tragic events (both natural and man-made) that occurred in the rest of the country and throughout the world.

Newspaper analysis indicates that the fatalities were no more noteworthy than reports of all the other risks associated with daily life in the late 19th and early 20th centuries.

Other Indicators of Fatality Related Concerns

In 1883 the New Jersey Bureau of Labor surveyed working people about the conditions of their lives. Many of those surveyed were engaged in dangerous and unhealthy trades—carpenters, iron miners, iron molders, machinists, glassworkers, textile workers, and hatters. They complained about poverty, the power of capital, and long hours. Some worried that they would be displaced by machinery or convict labor or about the alcohol addiction of their co-workers. Many urged the need for compulsory education. Yet, except for the cigar makers who complained about tobacco dust, no one commented on the unhealthy or dangerous nature of their work (pp. 113-115).

"That poor people are used to trouble is a commonplace," (p. 225) observed Crystal Eastman in 1910, suggesting that lack of worker concern over work accidents simply reflected the realities of working-class life. Death, injury, and illness on the job were matters of fact, just as the death of a child or spouse from a host of diseases like diphtheria, typhoid, or TB that thrived under working-class living conditions. Eastman observed that most workers and their families spoke of work injuries and other misfortunes as a "matter of course" (p. 225). Work accidents were to be endured.

Although from the Copper Country, the following quote validates Eastman's observations:

> Seven months after our first child was born, my left arm was badly fractured at the elbow...From that day my forearm and hand was entirely useless and hung helplessly at my side.
>
> The question of compensation or liability was unknown. We accepted injury as an unfortunate experience and the consequent burden was personally assumed (Jarve, 1998, p. 24).

An indicator, however, of the fact that the miners did feel their job was dangerous was found in the *Ishpeming Iron Agitator/Ore* which reported that as early as 1882 some type of accident insurance was carried by many of the men.

> ...killed by a fall of rock at the Spurr Mine. He had a $500 insurance policy (*Ishpeming Iron Agitator/Ore*, December 2, 1882).

> Gustaf M. Ceyllen was killed when hit in the back by falling rock at Winthrop Mine. He had a Travelers insurance policy (*Ishpeming Iron Agitator/Ore*, July 26, 1884).

> John Murphy was killed when he fell down the shaft at Champion Mine. He was insured with Travelers Insurance Company (*Ishpeming Iron Agitator/Ore*, November 1, 1884).

Many men also paid into "miners funds or clubs" where small contributions from their weekly wages went into a fund for their widows and children in case of their

death or injury. The general custom was that the company collected 25 cents to 50 cents each month from each employee, to which total sum the employer (in most cases) added an equal amount. This money was distributed to injured men or to the widows of men who were killed (Mather, 1898).

> Stephen Sellwood died from a bad cut to his head at the Cleveland Mine. He had club insurance (*Ishpeming Iron Agitator/ Ore*, April 5, 1884).

> Miner Fred Engman was killed by a falling rock at Lake Superior Mine...He had a $500 Travelers Insurance policy and will receive $400 from the miners fund (*Ishpeming Iron Agitator, Ore/* March 13, 1886).

The men at the mine and the company also contributed to a widow in the event of a man's death.

> It was agreed between the company and the men that they would work up to the afternoon of the funeral each giving $1.00 of the earnings to the widow and the company contributing a like amount. This will give the widow of each man approximately $500 (*Ishpeming Iron Agitator/ Ore*, October 2, 1886).

Certainly the insurance companies viewed the work as dangerous. From the *Ishpeming Iron Agitator/ Ore* of October 2, 1886;

> Accident insurance companies complain of their risks in the mining regions and threaten to raise the rate of insurance. The Travelers sometime since did this and others will be forced to follow. The companies claim they have lost money in this field.

In addition to the fact that death was common everywhere and death and injury were considered an unavoidable part of the miner's occupation, another factor contributed to the apparent acceptance of the high number of fatalities in the mines. That was the fact that although the cumulative number of deaths was large, only with rare exception did the mine fatalities number more than one or two at a time. This was not true of American coal mines where more than 300 men might be killed in a single

accident. The result was that the people of the iron country did not view the mines to be as dangerous as those of coal nor was iron mining considered any more, and perhaps less, dangerous than railroading or a host of other occupations or natural events. Three editorials found in the *Ishpeming Iron Agitator/ Ore* support this conclusion:

> While we read with sorrow the accounts of the killings, by accident of these sturdy men of our region, we can at the same time feel pleased that we are visited by no such appalling calamities as are constantly occurring in the coal mines of the east where men's lives are sacrificed by the hundreds through gas explosions and other causes (March 20, 1886, p. 5).

> While there are many men killed and injured in the iron and copper mines of this district, yet the percentage is much less than shown in the coal fields of this country. Every few days the papers bring to us the news of some terrible explosion, that carried away from ten to a hundred lives. We have none of the explosive damps of the coal mines, that are a constant menace to the safety of the miner (January 10, 1891, p. 5).

> There seems no way of preventing these distressing casualties despite utmost caution that is observed. Mining is a dangerous avocation and accidents must be expected as long as it is kept in force. Nearly every paper brings to our gaze the story of some fatality. In the coal mines of this country and Europe hundreds are often killed at once by gas explosions. We fortunately have not to deal with that terrible enemy here. The railroads annually kill a great many men, the Great Lakes and oceans swallow up thousands every year. Cyclones and conflagrations, blizzards and floods, plagues and wars all claim their share and there seems to be no remedy (March 17, 1888).

It can be seen in Table 5 and Figure 5 that while railroading was certainly more dangerous than iron mining, iron versus coal was a different story. Looking at the average fatality rates for the first decade of underground iron mining on the Marquette Range it can be seen that the fatality rate was actually higher for iron than for bituminous coal and only a little lower than that for anthracite coal.

Incidence of Strikes as an Indicator of Acceptance of Mining Related Fatalities on the Marquette Iron Range

The apparent acceptance of dangers associated with their jobs is also supported by the fact that initially the iron miners and, in fact, all workers did very little to improve working conditions for themselves. The U.S. Commissioner of Labor report on the causes of strikes by industry from 1881 through 1900 indicates that even in the most dangerous industries, safety was almost never the main motive for a strike. For example, in the coal and coke industry, the Commissioner reported 14,575 strikes attributed to more than 300 causes. Of these there were 6 strikes for better ventilation, one against an unsafe mining machine, one to enforce a state law governing timbering, and one to get a new safety catch on an elevator cage. There were also five strikes opposing the introduction of a new safety lamp and one to allow smoking in the mine during lunch (U.S. Commissioner of Labor, 1900, Table 10).

Although work in the iron mines on the Marquette Range was certainly viewed as a very dangerous job, the first strikes that occurred were not over working conditions either. The first significant strike on the Marquette Iron Range occurred in 1874, before the era of underground mining began, when the iron mines felt the impact of the Panic of 1873. The strike was over a decrease in wages from $2.25 to $2.75 per day to $1.30 to $1.75 per day and did not concern working conditions (Boyer, 1959).

Table 5. Comparison of Annual and 10-Year Average Fatality Rates Among Underground Iron Ore Mines on the Marquette Range, Trainmen (a), Selected Metal Miners (b), Workers in Selected Industries (c), and Coal Miners (d); 1890-1939.

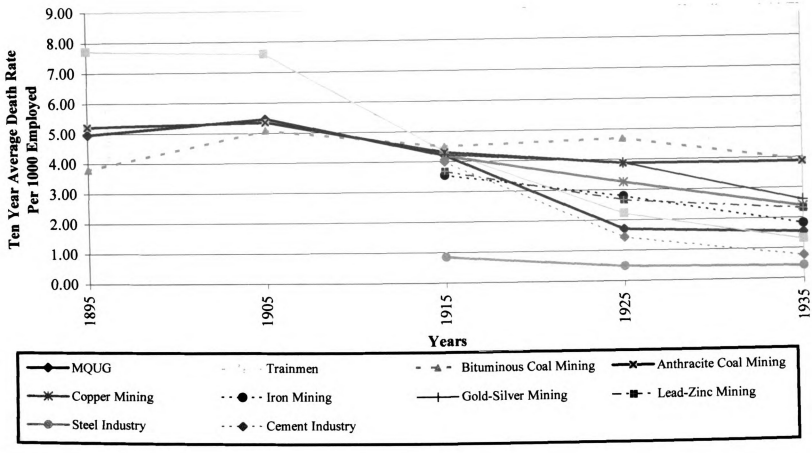
	MQUG		Trainmen		Copper		Iron		Au/Ag		Pb/Zn		Steel		Cement		Bit. Coal		Ant. Coal	
Year	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.
1890	5.45		9.52		—		—		—		—		—		—		2.85		4.50	
1891	4.50		9.57		—		—		—		—		—		—		3.85		5.01	
1892	4.79		8.88		—		—		—		—		—		—		4.17		4.91	
1893	4.65		8.72		—		—		—		—		—		—		3.32		5.21	
1894	4.56	4.96	8.26	7.72	—	—	—	—	—	—	—	—	—	—	—	—	3.96	3.81	5.34	5.22
1895	4.10		6.45		—		—		—		—		—		—		4.76		4.51	
1896	7.19		6.59		—		—		—		—		—		—		3.92		5.79	
1897	4.50		6.05		—		—		—		—		—		—		3.64		5.64	
1898	5.17		6.68		—		—		—		—		—		—		3.75		5.57	
1899	5.19		6.46		—		—		—		—		—		—		3.91		5.72	
1900	4.83		7.30		—		—		—		—		—		—		4.79		5.15	
1901	7.43		7.35		—		—		—		—		—		—		4.21		5.40	
1902	6.52		7.42		—		—		—		—		—		—		5.13		5.25	
1903	4.44		8.09		—		—		—		—		—		—		4.63		5.01	
1904	4.97	5.47	8.96	7.61	—	—	—	—	—	—	—	—	—	—	—	—	4.98	5.09	5.73	5.36

	MQUG		Trainmen		Copper		Iron		Au/Ag		Pb/Zn		Steel		Cement		Bit. Coal		Ant. Coal	
Year	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.
1905	5.27		8.10		—		—		—		—		—		—		5.02		5.43	
1906	4.57		9.20		—		—		—		—		—		—		4.06		5.28	
1907	7.32		7.98		—		—		—		—		1.68		—		6.40		5.77	
1908	3.98		6.78		—		—		—		—		—		—		5.44		5.80	
1909	5.40		4.87		—		—		—		—		—		—		5.88		4.78	
1910	5.50		5.41		—		—		—		—		1.20		—		5.53		4.65	
1911	6.47		5.16		5.18		4.64		4.28		4.03		.72		—		5.02		4.90	
1912	3.53		4.81		4.53		3.90		4.32		4.28		.96		—		4.46		4.48	
1913	3.59		4.63		4.08		3.29		3.83		3.90		.96		—		4.90		4.10	
1914	5.83		4.63		3.85		3.78		4.06		4.32		.72		—		4.90		4.05	
1915	3.56		3.15		3.72		2.88		4.79		5.37		.48		—		4.47		4.33	
1916	3.50	4.21	4.14	4.36	3.64	4.20	3.41	3.55	4.05	4.23	3.14	3.68	.72	.86	—	—	3.38	4.51	4.11	4.31
1917	3.56		4.30		5.88		3.54		4.03		4.09		.96		—		4.33		3.98	
1918	3.54		4.39		3.45		3.45		4.27		3.58		.96		—		3.97		3.83	
1919	3.06		3.02		3.54		3.09		4.41		4.13		.96		—		4.16		4.64	
1920	2.59		3.60		3.43		2.34		4.20		3.37		.48		2.16		3.79		3.74	
1921	1.38		2.15		3.70		3.04		3.29		2.58		.48		1.68		4.38		3.80	
1922	.69		2.27		3.00		3.00		5.35		2.64		.48		1.92		5.16		3.81	

	MQUG		Trainmen		Copper		Iron		Au/Ag		Pb/Zn		Steel		Cement		Bit. Coal		Ant. Coal	
Year	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.	%	Avg.
1923	3.39		2.61		3.11		2.38		3.93		3.73		.48		1.44		4.65		4.62	
1924	2.24	1.71	1.99	2.23	3.55	3.27	2.95	2.80	4.99	3.90	2.76	2.67	.72	.50	1.68	1.44	5.39	4.71	3.39	3.89
1925	.46		2.14		2.94		2.54		3.83		3.32		.48		1.44		4.79		4.12	
1926	1.50		2.08		3.45		4.23		3.27		3.05		.48		1.20		4.86		3.37	
1927	.92		1.98		3.46		2.45		3.91		2.64		.48		.72		4.60		3.94	
1928	1.52		1.61		3.03		2.16		2.60		1.62		.48		.96		4.90		3.85	
1929	2.40		1.88		3.03		2.98		3.66		2.08		.48		1.20		4.63		4.24	
1930	5.68		1.49		2.76		2.68		4.49		1.63		.48		.72		5.26		4.62	
1931	2.50		1.20		3.01		1.91		2.88		2.56		.48		1.20		4.42		4.43	
1932	0		1.31		3.01		1.18		3.66		3.95		.48		.48		4.85		3.83	
1933	0		1.26		2.49		1.82		2.20		.85		.48		.48		3.58		3.58	
1934	1.98	1.55	1.21	1.31	1.96	2.40	1.59	1.83	1.33	2.61	.91	2.32	.48	.43	1.20	.77	3.52	3.93	3.61	3.88
1935	1.27		1.29		2.05		2.15		2.86		2.26		.48		.72		3.53		4.26	
1936	.55		1.53		2.60		2.01		2.70		3.33		.48		.96		3.46		3.73	
1937	.91		1.44		2.26		1.73		2.60		1.47		.48		.96		3.74		3.44	
1938	1.03		1.21		1.66		1.69		1.27		3.38		.24		.72		3.68		4.08	
1939	1.54		1.13		2.17		1.55		2.08		2.88		.24		.24		3.29		3.61	

Source: (a),(b), (c), (d) from Aldrich, 1997, pp. 284-285, 300-301, 306-307, 310-311.

Figure 5. Comparison of the Ten Year Average Fatality Rates Among Underground Iron Ore Miners on the Marquette Range, Trainmen, Selected Metal Miners, Workers in Selected Industries, and Coal Miners: 1890 - 1939.



In October 1890, another strike occurred which lasted two weeks. This strike was over hours (miners wanted an 8-hour day) and the desire by the miners not to work Saturday night but still receive pay for six full days. During the strike, there were objections by many men who wanted to return to work, citing their need for the job (*Ishpeming Iron Agitator/Ore*, 1890, October 11, p. 5).

> They say that they have no objection to men quitting who want to, but such men should not say to them that they must also go out thus robbing themselves and families of wages they could earn and of which they are in need (1890, October 11, p. 5).

The strike ended when the men quietly returned to work. The *Ishpeming Iron Agitator/ Ore* commented,

> There certainly should be a kindly feeling between the men and their employers...Upon the success of the one depend the prosperity of the other. Labor and capital are partners in this mining business... (1890, October 18, p. 5).

Short lived strikes at individual mines over such things as late delivery of pay or increased working hours occurred sporadically, however, on July 13, 1895, miners walked out of the Lillie and Cambria mines on the Marquette Range in protest of low wages caused by the general depression suffered by the country in 1893 (they were earning $1.80 per day and demanded $2.00). This strike quickly spread to other mines on the Marquette Range and the miners organized a union to conduct their operations. The union demands included a standard wage paid in all mines, a wage increase, and union recognition. Again, this strike, which lasted nine weeks, was not over the dangerous conditions in the mines. Working conditions were not as important an issue to the miners as wages were. Although dangerous, the conclusion that working

conditions were not as important as wags to miners is supported by strike histories in the eastern coal fields.

Supporting Evidence From the Coal Mining Industry

The same strike patterns can be recognized in the coal mining industry which has long been acknowledged as one of the most dangerous industries in the United States. Although the data (see Table 5) indicate that underground iron ore mining was at least as or more dangerous than coal mining. This similarity in danger was not recognized as such by the iron miners themselves.

Coal mining has long been acknowledged as the most dangerous industry in the United States. When the United Mine Workers of America was formed in the coal fields in 1890, the main problems for the union were maintenance of membership, recognition of the union, opposition of employers, low wages, and unfair labor conditions. Safety was a peripheral concern and took a back seat to attempts to abolish company stores, the screen coal system, to obtaining checkmen, weekly paychecks, and compensation for dead work.

Analyses of the disputes under contract in the Illinois and southwestern anthracite coal fields reveal that miners seldom used the formal grievance mechanism to complain of, or attempt to remedy, dangerous working conditions within the mines. The grievance system was more often used by miners to secure the reinstatement of workers dismissed for safety violations than to protest an unsafe condition.

Before and after the establishment of collective bargaining in 1898 in the coal mines, the issues of strikes reflected the fundamentally economic values of the union and its membership. Safety often appeared as an auxiliary issue in a strike. In the

Anthracite Strike of 1902, hazardous working conditions appeared not as one of the miner demands for remedy but as justification for the miners' call for a 20% wage increase.

Safety legislation was also a cause of strikes in the coal mines. In 1909 the Technologic Branch of the U.S. Geological Survey, which had supervision of the federal government's limited effort in coal mining safety, established a list of "permissible" explosives. These were explosives that were tested by the Technologic Branch and were determined to be much safer than black powder, explosions of which often killed hundreds of coal miners at a time. In the same year, opposition of Ohio miners to a piece of legislation which would have prohibited the use of black powder was based primarily on the higher cost of the substitute explosives. Miners in Pennsylvania staged a major strike when they learned that the permissible explosives chosen by the operations would reduce earnings by shattering the coal much more than black powder did. As late as 1922, the "permissible" explosives accounted for only 18% of the explosives in use in coal mines (Graebner, 1976, p. 48).

The Red Ash explosion in 1900 prompted the *United Mine Worker Journal* to note, "West Virginia is noted in the mining world for her insufficiency of proper laws for the insurance and protection of her miners" (Graebner, 1976, p. 73).

This critical evaluation elicited a reply by West Virginia Governor G. W. Atkinson, "It is but the natural course of mining events that men should be injured and killed by accidents" (Graebner, 1976, p. 73).

It can be seen from the data below that this negativism about mine safety in the coal regions was reflected in a very high number of fatalities.

1900—1 disaster; Winter Quarter Mine, Utah; 210 died
1906—17 disasters; 235 died
1907—1 disaster; Monongah, West Virginia; 361 died
1907—18 disasters; 918 died
1908—11 disasters;348 died
1909—19 disasters; 498 died
1910—(the year Congress created the Bureau of Mines to help make coal mining less dangerous)—19 disasters; 485 died (Graebner, 1976, p. 3)

Although the fatality rates (deaths per thousand employed underground) were about the same for coal mining and iron mining on the Marquette Range for the 1900 to 1910 decade, it can be seen that the number killed per accident was much larger in the coal mines than in the Marquette iron mines. This is the reason that coal mining was perceived to be so dangerous relative to iron mining and it is what drew public attention to the dangers associated with mining as journalists wrote about the numerous large coal mine disasters which occurred prior to 1910. However, except for the Dawson, New Mexico, explosion in 1913 which killed 233 there were no large coal mining disasters after 1910 and pressure for reform decreased. The general public and media, inured to death as a common occurrence in the late 19th and 20th centuries, took no notice of the small number of mine fatalities that occurred on the Marquette Iron Range.

In fact, before the Bureau of Mines was created in 1910 to investigate and help reduce coal mining accidents, earlier bills to establish a bureau or department of mines that were presented in the House and Senate did not mention mine safety—coal or metal. Their purpose was to promote and encourage mining and metallurgy, and to aid in the development of the nation's mineral resources.

Even after the Bureau of mines was founded, many envisioned it as a conservation agency. The state of the nation's natural resources was a concern of the times and occasionally, the natural resource aspect of conservation was linked to the mine safety issue. Unsafe mining techniques were attacked as wasteful of the natural resources as well as lives.

Funding for the Bureau of Mines to study mine safety met many roadblocks. In 1914, Seattle attorney Maurice Leehey noted that the appropriations for the Bureau of Mines "just equaled the amount appropriated by Congress for investigations in the treatment of hog cholera..." (Graebner, 1976, p. 51).

By 1914 the Bureau's priorities in coal mining safety and health problems began to decline. World War I accentuated this relative decline in interest in coal mining safety and an increased interest in a variety of other areas; smelter smoke, the production of radium, and the manufacture of gasoline, benzol, and toluol from petroleum.

Continuing indifference to coal mine safety on both the part of the government, the coal miners, and the mine owners is reflected in the continuation of high fatality rates in coal relative to iron mining in which a significant and permanent decline began in 1912. In fact, after 1920 the underground fatalities per year on the Marquette Range never reached double digits again (Barnes-Hecker omitted).

But as dangerous as it was acknowledged to be, iron mining was undoubtedly viewed as the salvation of the area and of the people who came to work in the mines. Mining provided jobs and necessary income and of course iron ore for the growing economy.

CHAPTER 8

ANALYSIS OF FACTORS CONTRIBUTING TO THE HIGH FATALITY RATES IN UNDERGROUND MINES ON THE MARQUETTE IRON RANGE

Introduction

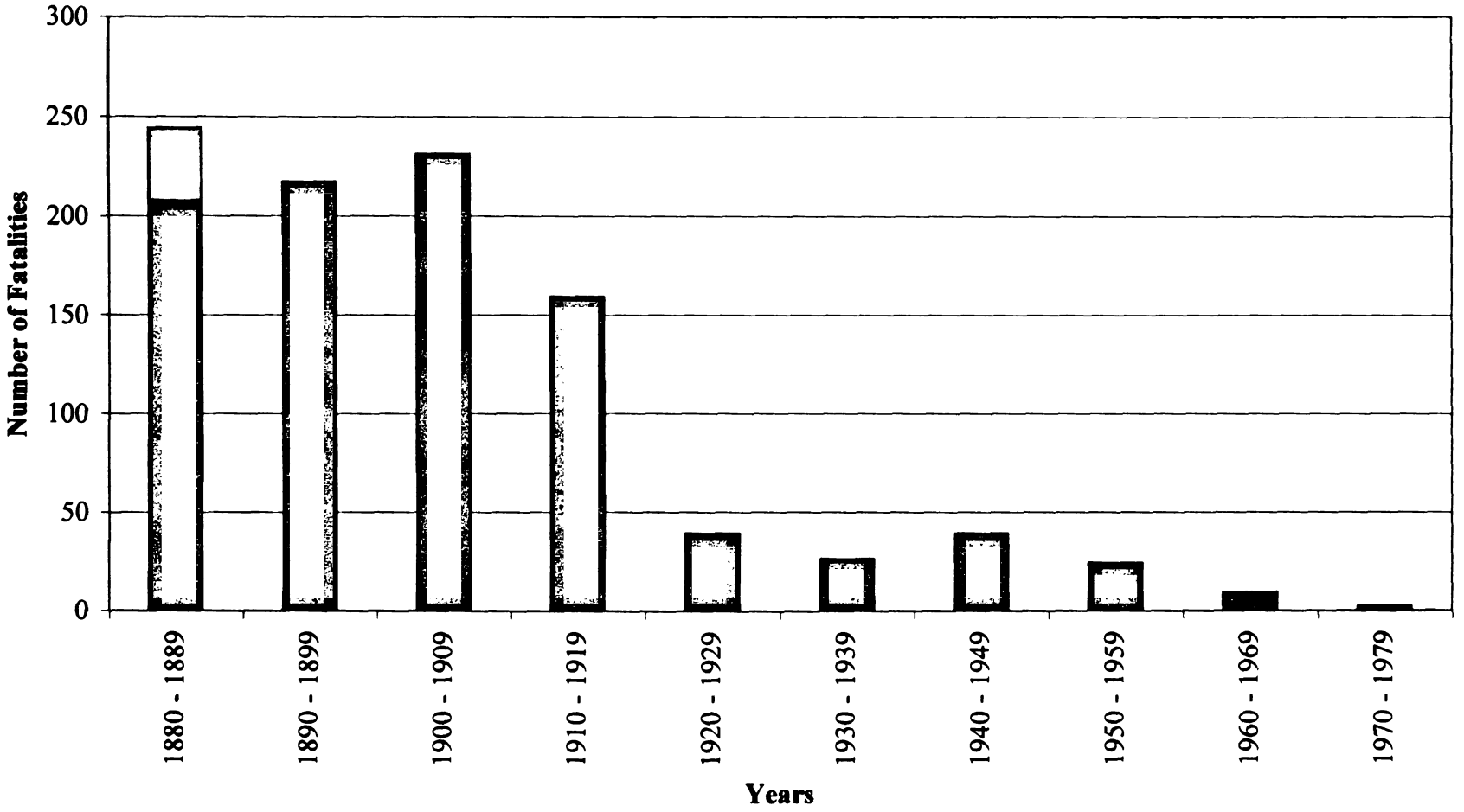
In order to determine the factors involved in decreasing the social cost of iron ore mining on the Marquette Iron Range, it is first necessary to examine the fatality rates (the proxy of social cost) for the Range and explain why, initially, they were so high. Examination of the data in Tables 4 and 5 and Figures 2, 3 and 6 shows that the number of known fatalities and the fatality rate increased slowly for the first three decades of underground mining. Then in 1920 a decrease of 75% in the average number of fatalities from the previous decade is noted (a 59% decrease in fatality rate). It can be determined from Figure 6 that approximately 86% of the fatalities on the Marquette Range occurred before 1920.

Examination of Factors Contributing to Fatal Accidents on the Marquette Iron Range

Eight factors that were considered to be contributors to the high fatality rate were listed in the Introduction and are reiterated here:

1. Laxity in mine discipline and lack of managerial control of the miners and mine operation.
2. Demand for labor greater than supply resulting in the employment of inexperienced labor.

Figure 6. Total Number of Fatalities by Decade in the Underground Mines on the Marquette Iron Range: 1880 - 1979.



3. Absence of any laws forcing the companies to employ only trained miners in the responsible and dangerous occupations or to provide inspection of mines or mine equipment to ensure safe working conditions.
4. Lack of any laws forcing compensation for fatalities by the employer.
5. Inability of the majority of employees to speak English or understand the orders and directions given them.
6. Carelessness or recklessness on the part of many of the men employed.
7. Old technologies or mining methods used by a multitude of small companies or, on the other hand, new technologies that provided new and unfamiliar dangers.
8. Unavoidable "acts of God."

The high fatality rate in the first three decades of underground mining on the Marquette Iron Range cannot be attributed to one factor alone. Many factors played a role in allowing some of the highest fatality rates in the mining industry to be achieved in the Marquette Iron Range underground mines.

Although it is not possible to determine the proportional contribution of each factor to the high fatality rate, it is important to examine them so that their relative importance in lowering the fatality rate can be assessed. Logic suggests that changes in one or more of these factors were responsible for lowering the fatality rate beginning in 1912. The lower rate became even more marked beginning in 1920.

Laxity in Mine Discipline and Lack of Managerial Control of the Miners and Mine Operation

The laxity in mine discipline and lack of managerial control of the miners and mine operation that was found during the early decades of mining stemmed from three factors; the use of the contract mining system, mine operators' lack of knowledge of how to run a mining operation, and the push for production as demand for ore rapidly increased.

The Contract Mining System

The first mining on the Marquette Range was accomplished by Cornish miners who migrated to the area as economic conditions and declining mines in their own country forced them to look for better opportunities. These men brought with them mining skill and the contract mining system. The contract mining system defined key relationships between miners and managers that reduced managerial control of the miners and the mine operation. The lack of control fostered by the contract mining system resulted in conditions that contributed to the high fatality rate.

A miner in the capacity of a contractor would bargain with the mine captain as to the price for a specific job. He received "tribute" or a share in the value produced when working on ore bearing rock, and so much per foot (or fathom) when performing "dead work," that work necessary to remove rock which produced no ore. Sometimes the men were not paid for the dead work. Often this work was done hurriedly and carelessly because there was no profit to be realized. "In booming times," reported the Bureau of Labor and Industrial Statistics in 1896, "contract miners on iron ore may

make as high as $4 or $5 per day in case they strike a favorable condition underground" (p. 331).

The gangs of men worked under the direction of a mining captain or superintendent, whose duty it was to see that the work was done according to contract, and to have the ground secured properly. Generally, however, the contract miners labored largely as they pleased. Timbering, track laying, drilling, and blasting were only loosely supervised by the company. Some of the larger mines had separate gangs that were especially skilled to do the blasting while in others the miners did their own blasting. Usually the contract miners were relatively independent and worked with a minimum of supervision, often rejecting orders of the captain and rules of the company.

The contract miner was essentially a skilled and autonomous craftsman who worked at his own pace in his own way. Although he was an employee subject to company rules, custom gave him the status of an independent contractor. As such he also supplied his own tools and sometimes hired a boy or laborer to help him who was not even listed as a company employee.

Contract mining in the iron mines was much like that in the coal mines where, as described by David Brody in *Workers in Industrial America*:

> The miner provided his own tools, knocked off early when he chose, worked at his own pace, and exercised his own judgment in his 'room' (or 'contract') at the coal face. That was one of the greatest satisfactions that a miner had that he was his own boss within his work place. And he took pride in his craft (Brody, 1993, p. 4).

However, the system of contract mining often led to dangers that could only be alleviated with more managerial control. The ambiguity over whether miners were

employees or independent operators carried over into matters of safety, and the men's freedom to determine work practices often led to tragedy. It also blurred responsibility. Because danger usually resulted from a combination of work practices and working conditions, it allowed operators to blame accidents on the "careless" behavior of the men. Miners, on the other had, tended to see the chances they took as their own business and blamed all other dangers on the operators. Thus, each group saw safety as the responsibility of the other.

The mining companies on the Marquette Range used both contract miners and miners who were paid a daily wage. In 1898 the Bureau of Labor (15th Annual Report) reported 1,750 contract miners and 343 miners on company account working on the Marquette Range (p. 286). But even then the companies were limiting miners' work by contract to each earning only a certain amount per shift. "...and in cases where they overreach this limited figure they are compelled to stand a reduction on the next months contract" (Bureau of Labor, 1898, p. 284).

By the first decade of the 20th century, the necessity for efficiency engineering and rigorous cost control began to erode the contract miner's status. The miners earned what the company wanted to pay regardless of the terminology and true contract mining had largely disappeared. Although many miners continued to use the term "contract miner," between 1900 and 1910 most of them punched daily time cards for the first time. By 1904 the Bureau of Labor reported 1,842 miners on contract and 811 on company account earning a wage of $3.22 to $1.55 per day. The miners work "by contract" was limited to each earning a certain amount per day or shift (Bureau of Labor, 1904, p. 128).

The major effect of contract mining on mine discipline and control and its contribution to fatal accidents decreased gradually throughout the late 1800s and early 1900s. There was no sudden change in the system that would cause the large decrease in fatal accidents and fatal accident rate seen in 1920.

Lack of Skilled Management

During the period when the iron mining fatality rate was the highest, there were many mines owned and run by many small operators. Many managers simply lacked the knowledge and skill to run safe mines. Operators' lack of skill resulted in part from the shared belief that the miner was responsible for his own safety, and in part from the low cost of accidents for the operator.

Also, in the early years the mining proceeded without a defined plan of operation. When ore was discovered the idea was to remove as much as possible quickly and cheaply. There were no development plans and the best methods to use to remove the ore had to be learned as the operation progressed. Nor was the mine considered to be a long-term operation. The presence of much rich ore and the rapidly growing demand for it hindered the learning process necessary to run a safe mining operation.

The cost and complexity involved in obtaining ore from the rapidly deepening mines forced improvement in the management and operation of the mines and thus in the skill level of managers and operators. This happened quite rapidly throughout the latter part of the 1800s, and its effects on accidents would have occurred long before 1920. Also, a sudden decrease in deaths due to this factor would not occur because there were differences in management and operation among many mines.

Push for Production

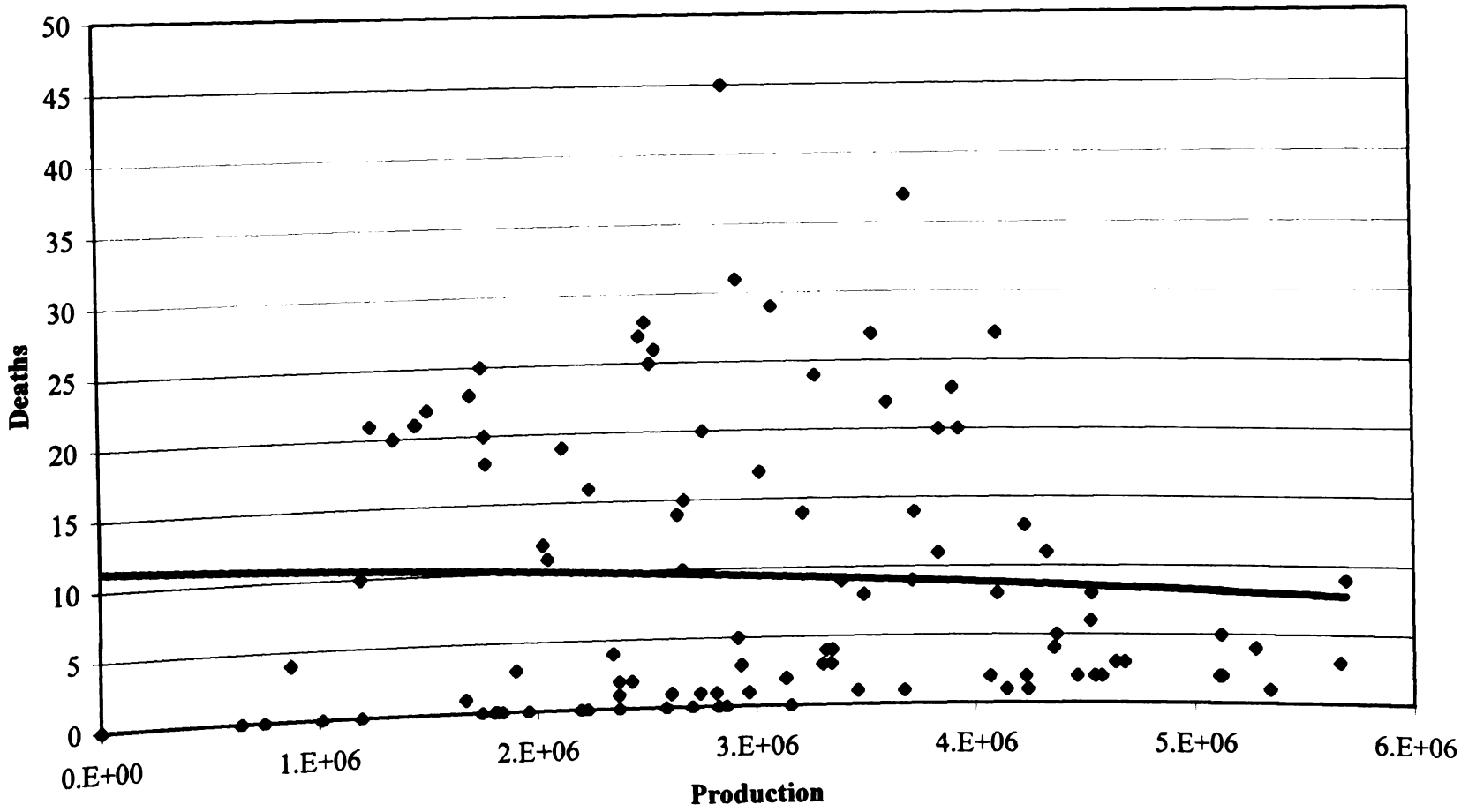
Additionally, the demand for ore throughout much of the early mining period was great. The mines worked day and night and the shift bosses often competed with each other as to how much ore their shift could produce. At the LSMI meeting in 1913 Edwin Higgins noted, "The demand for over production might come from the management or officials, or, as is often the case it might result from the spirit of rivalry that exists between some captains or shift bosses" (p. 64). Also prevalent was the belief that the man's worth was gaged by the amount of ore he could produce:

> Everybody was hard working. Everybody wanted to show what they could do. There was a better spirit for that. Even if you were working with a shovel, you wanted to show what you could do. There was nobody that tried to lag behind. I don't know what created the purpose, but each crew, each shift, would try to beat the other. At the Baltic there were 350 skips of ore the first night I was there. When one crew got a few more, the other tried to tie that up. That is the spirit of the time (Bernhardt, 1975, no pagination).

Forcing the production of more ore than could be produced under normal working conditions contributed to the high fatality rate. Higgins summarized the situation in 1913; "When working places are overcrowded with men and machinery and the mine equipment is being worked beyond its capacity, there is a tendency for the work to go with s slam and a bang that allows little chance for anyone who happens to get in the way" (p. 64). The push to get the most production possible, for whatever reason, also fostered the lack of discipline and control necessary to prevent fatal accidents from occurring.

Overall, the relationship between fatalities and production is slightly negative (see Figure 7). High production is associated with a lower number of fatalities. This is

Figure 7. Number of Underground Fatalities vs. Production of Iron Ore on the Marquette Iron Range: 1880 - 1979.



due to the fact that in the later years of mining improvements in machinery and mining methods allowed a much greater production of ore, by fewer workers, than had ever been possible before. The actual effect of a push for production can be seen in 1942 when 5,692,542 tons of ore, the largest tonnage in the history of the Range, was produced. The death rate rose to 3.27, the highest it had been in a decade. Part of this increased rate is possibly attributable to the fact that the overall skill level of the workforce was diminished by the massive increase in armed forces at the beginning of World War II.

The contract mining system, lack of managerial skill, and the push for production contributed to the high fatality rate. Although changes in these factors would help lower the rate slowly over time, their involvement in a sudden decrease in rate would be negligible.

Demand for Labor Greater Than Supply Resulting in the Use of Inexperienced Labor

This factor played a role in the occurrence of fatal accidents on the Marquette Iron Range several times throughout its history. In 1913 Edwin Higgins told the LSMI:

> A scarcity of labor means that there are a correspondingly smaller number of experienced men available. It follows that green men must be employed in the mines and that incompetent men must be kept at work when they should be discharged. Such conditions are productive of accidents. Where an entire district is effected by a shortage of experienced labor, as it may be when production rates are very rapid, accidents tend to increase (p. 65).

The Marquette Range was the first of the Lake Superior iron ore districts to be discovered and initially drew highly skilled Cornish miners from the declining mines of their own country. These men held positions of authority in the mines as skilled

miners, bosses, and captains. They were highly valued by the mining companies for their mining skill. The opening of new iron ranges in Michigan and Minnesota, the Menominee in 1876, the Gogebic in 1884, and the Vermilion and Mesabi in the late 1880s and early 1890s provided new opportunities for these skilled miners and during this period many left the Marquette Range for the new ranges which were believed to offer better opportunities, both with regard to advancement and working conditions. Also, somewhat later many went west to Colorado, Montana, and Nevada.

Strikes (especially the strike of 1895), unsettled economic conditions and lowering of wages, especially in the 1890s associated with the Panic of 1893, increased the migration of skilled workers out of the Marquette Iron Range. This migration, the slowing of immigration from England, and the constant expansion of the mining industry created a demand for new workers. Helpers and other laborers were promoted to fill the vacancies. Although the skill level necessary was gong down due to mechanization, still in all the "new miners" had little mining experience in their background.

After 1895 there was a great increase in the employment of new immigrants. Finns, Italians, Belgians, Poles, Montenegrins, and Slovaks gradually replaced the skilled English (Cornish) miners. This shift put the unskilled in positions of responsibility and played a role in range fatalities. By 1911 the Finns were employed in greater numbers than any race. Of all the immigrants, the Finns represented those with the least amount of prior mining experience. Only 0.4% of the Finns employed in the iron mines in 1911 had prior experience in mining (see Table 6). In fact, only a small percentage of all new immigrants to the Iron Range were employed in mining before

coming to the United States: 9.8% were employed in mining and 75.5% in farming, farm labor, and general labor (see Table 6).

Table 6. Percent of Foreign-Born Male Employees in Each Specified Occupation Before Coming to the United States, By Nationality.

Nationality	Number Reporting	Mining	Mfg.	Farming	General Labor	Hand Trades	Trade	Other
Croatian	81	13.6	0.0	59.3	23.5	1.2	0.0	2.5
Finnish	522	0.4	1.7	68.8	22.8	5.0	0.0	1.3
Italian, N.	435	14.5	3.4	49.0	22.3	7.6	.7	2.5
Polish	302	9.9	3.0	57.3	21.9	5.0	0.0	3.0
Slovak	113	6.2	6.2	67.3	14.2	4.4	0.0	1.8
Swedish	129	10.1	9.3	48.8	13.2	8.5	1.6	8.5
Total	1,940	9.8	3.6	56.0	19.7	6.6	.4	3.9

Note: From *Immigrants in Industries, Part 18: Iron Ore Mining*, 1911, Table 148, p. 413.

The effect of the unskilled miner with respect to production was offset by great progress from 1880 to 1900 in techniques of mining and handling ore. About the middle of this period, mining machines were introduced which simplified removal of the ore and in addition to requiring less skill, greatly increased the output of the miner. This was not true, however, with respect to the occurrence of fatal accidents.

From Table 5 it can be seen that the three decades from 1890 to 1920 had the highest average fatality rates in the history of the Range. The effect of employment of the unskilled was a major contributing factor to these high rates. In 1909, John T. Quine of Ishpeming told the LSMI:

> The labor question is the most serious one we have to contend with at the present time. Skilled labor is getting scarcer every year in our mines due in part to the greater demand from new properties which are being opened.

Quine continued,

> I mean that almost every man that is out of employment looks for a position as a miner and it takes the constant care of the men in charge of underground work to keep these men from meeting with accident while at their work...Furthermore, in the copper and iron districts of Michigan, Wisconsin, and Minnesota, for some years past, the immigrants have mostly been non-English speaking people. This is a serious drawback in teaching them quickly (p. 72).

Analysis of death notices in the *Ishpeming Iron Agitator/Ore* also supports the conclusion that inexperience was a factor in fatal accidents. The examples given below indicate that these fatalities were caused by lack of experience, language barriers, or often both (see Appendix for additional quotes).

> John P. Frieburg, a Swede, was hit and killed by a falling rock at the Cleveland Mine. He had worked there one week (May 22, 1880).

> Charles Johnson, a Swede, aged 45, was killed at Lake Superior Mine when he fell down the shaft. He had worked there five months after coming to the U.S.A. (October 2, 1880).

> Edward Sprage, an Englishman, aged 25 was killed by falling ore at the Saginaw Mine. He had worked there 6 months (November 27, 1880).

> John Brewer a miner at Lake Angeline Mine was instantly killed Tuesday. He was 24. He arrived here 4 weeks ago and was killed his first shift at the mine (March 6, 1886).

> Charles Setterlund was killed at East New York Mine Monday last. It was his first day on the job. He went to secure a light for his candle, while waiting to go into the mine, from a companion and walked directly into the shaft. He fell 150 feet (January 18, 1890).

It can be argued that the natural course of mining accidents will be one of initial increase and then slow decrease over time as both miners and managers gain

experience. Although increase in skill and competence of the workforce was a factor in the overall decrease in death rate over time, it alone cannot explain the drop seen after 1919.

Absence of Laws to Provide Inspection, Train Miners and Ensure Safe Working Conditions

The absence of state laws pertaining to the training of miners or requiring inspection of mines and mine equipment has always been the case with respect to underground metal ore mines in Michigan (State of Michigan, Department of Labor, 1962, p. 19). Experience was the teacher of both the miners and the mine operators but there were no formal requirements for apprenticeship or certification. While the mine captain may have had experience there was no test given to assess whether he knew more or had better judgment than the men under his direction. Also it was the operator's responsibility to oversee the condition of equipment and general safety of the mine. There was no input from anyone outside of the mining operation.

Recall from the discussion of the contract mining system that although the mine captain oversaw the fulfillment of the contract and was supposed to see that the ground was properly secured, the miners worked mainly as they pleased. In most mines they did all of the necessary work without much supervision and often with disregard of any existing company rules. There were no legal penalties for disobeying company rules that did exist, personal safety was the responsibility of the individual miner.

As use of the contract mining system declined, jobs became more specialized. The miners, however, were still inclined to take chances that resulted in fatal accidents.

As noted by the 21st Annual Report of the Bureau of Labor and Industrial Statistics (1904):

> It is the duty of the mining captain or shift boss to examine the breasts of all drifts and crosscuts and all stopes, note the progress and examine into the condition of the hanging. The timber men who attend to the securing of such openings are not so often the victims of accident as the miners, who are frequently inclined to take great and unnecessary risks in such places (p. 105).

In 1909 John Quine, addressing the LSMI, stressed the causes of most accidents and the need for laws. Quine noted that failure to follow orders was a problem to mining captains and stated that:

> Our fatalities largely occur through carelessness or from disobeying orders.

He concluded,

> I firmly believe that the time is not far distant, if not already here, when the employers of labor, or the law makers of our country will have to adopt more stringent measures or laws governing the mining industry, that will make it punishable by fine, imprisonment, or instant dismissal from the employment in cases of this kind (i.e., disobeying orders) (p. 73).

The State Mine Inspector Law

As early as 1886 there was agitation in the Upper Peninsula for the appointment of a mine inspector. The stimulus was the large number of tragic accidents and fatalities that occurred in the mines and the precedent was the appointment of state mine inspectors in the Pennsylvania coal mines. The agitation for a mine inspector did not appear to arise in the iron mines but rather in the copper country where journalists of the *Hancock Herald* were the first to take up the issue. The idea was also supported by the *Marquette Mining Journal* but the *Ishpeming Iron Agitator/Ore*, in the center of

the iron mining district, was skeptical of it. Citing the expense and questioning the effectiveness of the law requiring a mine inspector, the *Iron Agitator/Ore* stated:

> It would require at least a force of 20 men to take care of the mining districts...Three for the copper mines, 10 for the Ishpeming field, 5 for the Menominee and 2 for the Gogebic. This would require an outlay of at least $50,000 per year and what benefit would the mines derive (April 3, 1886).

Each mining company had its own inspectors and the question was; Could an appointed state inspector do more toward preventing accidents than was already done? The *Iron Agitator/Ore* wrote:

> The facts are well known to the miners and they are the best judges of the case. The formations of the iron mines of this region are treacherous, and the question of how to prevent accidents is being as eagerly studied by the mine owner as by the (Hancock) Herald (April 3, 1886).

These two quotes provide good examples of the strong company viewpoint held by the Ishpeming newspaper. But in spite of any doubt that may have been promoted by the *Iron Agitator/Ore*, a bill to provide for the appointment of a mine inspector and defining his power and duties was introduced by Senator Hubbell (Senate Bill, no. 161) on February 16, 1887. The original bill provided that the governor of the state of Michigan would appoint an inspector of mines. The inspector or his deputy would inspect a mine every three months and would have the power to close the mine and require repairs if unsafe conditions were reported. Additionally, the mine superintendent or manager or captain or company official of the mine would be held personally liable for any loss of life or property if he neglected such repairs as required by the mine inspector. The *Ishpeming Iron Agitator/Ore* had this to say:

> There is nothing wrong in the appointment of such an inspector provided one competent to take charge of the duties of the position could be

> secured. On the selection all would rest...One inspector would have more than he could do, but as the companies generally take every needed precaution in the operation of their properties it would be useless to incur greater expense to the taxpayer than the paying of the salary of a single inspector. It might do to combine the office with that of mineral statistician (February 26, 1887, p. 1).

When the time to actually choose an inspector arrived, the proposed law had been changed considerably. The Marquette County Board of Supervisors now had the responsibility of filling the office and the *Iron Agitator/Ore* warned: "There are at the present time several applicants for the position who should not possess it upon any account. They being well know disturbers, whose chief aim would be to worry the companies rather than promote the welfare of the miners" (September 3, 1887, p. 1).

It is interesting that there is no mention of the influence that had the effect of significantly decreasing the objectivity of the original proposal. There is a considerable difference between a law, the legislative goal of which is to promote the safety of the miner, in which the mine inspector is appointed by the governor and one in which he is appointed by the Board of Supervisors of the county in which the mines operate. This has the potential, at least, of notably affecting the inspector's susceptibility to local influence and pressure.

The strong mining industry philosophy of the *Ishpeming Iron Agitator/Ore* can also be seen in the quotes taken from the newspaper that pertain to the Mine Inspector. Whether it is the personal philosophy of the editor or direct influence, by some means, of the mining companies on the editor is impossible to know now. It is evident, however, from these quotes and others than will be given, that the newspaper was strongly supportive of the mining industry.

Nowhere in the newspaper was there found any suggestion of opposition to the proposed mine inspector bill by the mining companies. Reportedly, their only desire was that since such an inspector was to be chosen, he would be free from any outside influences; dependent only upon his knowledge of mining affairs to direct his decisions The *Iron Agitator/Ore* noted: "As far as our observations has been (sic) the companies endeavor to keep their mines in condition to prevent accidents." They continued, perhaps without realization of the full significance of their words, "Mines that are dangerous to life also threaten capital" (September 3, 1887, p. 1).

No stated accusation of company influence of the mine inspector was found. Their lack of opposition to the law, as suggested by the newspaper, along with statements on later reports of the Mine Inspector indicate that whether he was directly influenced by the companies or not, he was at least sympathetic to their problems. From the reports of the Marquette County mine inspector, 1890 and 1905 respectively;

> Having examined every mine of the county this last year carefully, I am especially gratified to be able to state that there has been no failure on the part of any mining company or mine owner in supplying any demand that might in the least contribute to the safety or healthful condition of the respective mines.
>
> Without being able to report cases of neglect or of making suggestions of importance this report is respectfully submitted Anthony Broad, Inspector of Mines.

And from the report of John T. Quine;

> In all of my official visits I have received the usual courtesies from the officials and they have worked in unison with me in taking all precautions that were necessary to prevent accidents and I assure you that the men in charge of the different properties throughout the county are very careful of their men and try at all times to avoid accidents and particularly those of a fatal nature. There is nothing more discouraging to them than to have men lose their lives in or around their mines.

The Board of Supervisors offered a salary of $2,000 for the position of mine inspector which was deemed insufficient by the *Iron Agitator/Ore*. Fearing that a competent man could not be secured for less than $4,000 to $5,000 they made the following statement:

> The Board should pay a good man what he is worth. The majority of the tax to pay the salary comes from the pockets of the mining companies and they are desirous of securing a responsible man...it would be little less than an insult odd offer him but $2,000 a year. The county can afford an intelligent officer and ought to have one (September 17, 1887, p. 5).

At the Board meeting of September 24, 1887, Mr. Anthony Broad was chosen as the first mine inspector of Marquette County. Charged with inspecting all mines every 60 days, he was to receive an annual salary of $2,000, deputies furnished by the county, and 4 cents per mile traveling expenses. The *Iron Agitator/Ore* concluded: "Regarding the value of the service of such a position there are different opinions expressed. A trial will demonstrate it more satisfactorily, however" (September 24, 1887, p. 5).

As it evolved, the first mine inspector law was toothless. No power was given the inspector either to begin or recommend the beginning of actions against anyone. That the law was ineffective in reducing fatal accidents can be seen in the fact that the death rate did not decrease after the law was put into effect (see Table 4).

In 1895 J. Park Channing, addressing the LSMI, reviewed the duties of the mine inspector and assessed his effectiveness. By analyzing the mine inspector's reports for 1887 to 1894, Channing found that the underground fatality rate for all of the Michigan iron ranges averaged 5.670 per 1,000 workers. For Marquette County (1888

to 1894) the underground fatality averaged 4.768 per 1,000 workers (p. 38). Channing criticized the superficial nature of the law and the method of appointing the mine inspector and concluded that a better law was needed:

> It will be seen that the results are not to be commended...Taking all the figures into consideration the conclusion seems irresistible that the present mining law has not been a great success. The trouble with the law is that it is of a most superficial character and hardly can be dignified by the name of a mine regulation act. The method of appointing the mine inspector by the county board of supervisors, is open to criticism. This board is usually composed of mine managers or officials, and except by popular election, I can conceive no worse way of selecting a man. The salaries paid are small and as a consequence the best men do not seek the places (pp. 46-47).

By the time the fatality rate declined significantly, the office of mine inspector had been in existence for over 30 years (see Table 4). At the time the most significant decrease in fatality rate is observed, other than the mine inspector law, there was no state or federal regulation or inspection of the mining industry. The stimulus for the reduction had some other source.

In addition to the criticism of the new mine inspector law, there are several points in Channing's 1895 address to the LSMI that allude to the fatal accident problem. In a recap of the past year's Presidential address to the institute he stated;

> In his (the past president) address we saw the wonderful increase in efficiency of labor due to increased economical devices and the utilization of power. The question presents itself—Have we in the rush and push of the last 50 years' struggle for material prosperity, devoted a proper amount of attention to the life, health, and comfort of the miner? (p. 34).

As ineffective as the new law was in reducing fatal accidents in the mines, it was at least causing the companies to acknowledge the problem. One of the duties of the inspector was to record and report the number and causes of all fatal and non-fatal

accidents that occurred throughout the year. Although he rarely found the companies to blame for the accidents and they had very little liability, the fact that they were being recorded was important. Channing noted:

> The mere fact that every fatal accident is sure to be investigated and the occurrence published, has had a moral effect upon mine officials and although the status of the inspector is indeterminate and his actual authority nothing, his presence and suggestions have for these reasons considerable weight (p. 47).

In closing is address to the group, Channing encouraged all of them to consider the fatal accident question and also pushed for a new mining law:

> The time has come in Michigan when it is desirable that we take this question (fatal mine accidents) in hand and put our state in the fore. Our mining practice is the best, our machinery and our mills the largest and our shafts the deepest in the world. We should not be without a mining law commensurate in its completeness with our material success. I beg that the members of the Institute, and that the mine managers and their employees will carefully consider the figures and suggestions I have made and cooperate in checking this unnecessary loss of life (p. 48).

Report of the Bureau of Labor Concerning Laws and Regulations

Although encouraged by Channing, changes in the existing law did not take place for many years. In 1898 the Bureau of Labor noted the lack of inspection in the mines and non-compliance with the existing mine inspector law. The following excerpts are from the Bureau's 1898 report:

> While I am aware that a large majority of our mine managers are doing all in their power to prevent accidents and protect the lives of their employees, yet an impartial observer can but see that there are opportunities for valuable improvements in this line yet to be made (p. 200).

> It is indeed startling to consider the many accidents that are constantly happening from falling ore, or vein rock, which could be materially reduced in number by proper means of protection and more careful inspection...the experience of the mine inspector of New York...shows

> that the Empire state, by improved inspection and protection to the miners, has reduced the number of accidents more than 75 percent in the last few years (p. 201).
>
> Another matter of great importance is that the operator should provide automatic means for stopping the "men cages" at any moment...In such accidents where the machinery is not stopped in time, the parting of the cable permits the cage with its human freight to fall hundreds of feet with nothing to check it until it strikes the bottom. To any mechanic or person familiar with the safety appliances required by the State Factory Inspection Laws, such accidents can only be considered as the result of criminal negligence, when it is easy to provide an automatic trip or lock near the level of the surface, which in the event of an accident would totally check and stop the downward fall of the cage, and in such instances save the lives of all. We are cognizant of more than one fatal accident where several have lost their lives for the want of some simple device, which in a factory would be ordered immediately (p. 281).
>
> In my opinion the machinery of the mines and the question of proper guarding of all devices, shafts and well-holes should be incorporated in the Sate Factory Inspection Laws, similar to those of other states, where such mine inspection has proven most satisfactory and been attended by the greatest results (p. 281).
>
> ...I wish to kindly remind the mine operators of the fact that the Session Laws of 1897, in a section of the act creating the office of mine inspectors, provides for the construction of a partition between the ladder or cageway in the main shafts, to prevent accidents by falling rock or ore form the skips, which law I notice is not strictly observed in some of the mining districts (p. 281).

Although not directly stated by the Bureau of Labor report, the suggestion remains that even though modern mining equipment was introduced quickly, in order to obtain the most ore for the lowest cost, devices required specifically for the protection of the miners, such as safety catches on cages and partitions to protect them from falling rock, were obsolete or not provided. The following quote supports this suggestion:

> There was no written code, rules or regulations so far as the men were concerned. We had the County Mine Inspector elected by the people.

> But he was always playing the game with the mining company and with the men to get elected (Black Rock and Roses, no pagination).

The data supports the conclusion that lack of or disregard of laws providing inspection or ensuring safe working conditions contributed to the high fatality rate in the first three decades of mining on the Marquette Iron Range.

Lack of Any Laws Forcing Compensation for Fatalities by the Employer

Because of the legal doctrine of the time regarding liability for workplace accidents, there was little need for company concern, other than humanitarian, about the high death rate in the mines. Prior to the enactment of workmen's compensation legislation, employers' liability laws governed the liability of employers for accidents. The court held that the employer was to provide a safe place for employment, safe tools and equipment, competent fellow workers, and adequate supervision. If he did these things he was free from the responsibility of accidents arising from the worker's carelessness, the negligence of his fellow workers, the ordinary risks of the occupation, and the extraordinary danger of the job. All of these conditions were assumed to be known to the worker when he took the job. An injured employee's only resource was to sue his employer in court. If the employer could prove that he had taken any one of the necessary precautions, the injured worker or his family had little chance of receiving any compensation.

The defenses available to the employer were such that only an estimated 15% of injured employees ever recovered damages, even though 70% of industrial accidents were estimated to be the result of the nature of the work or of employer negligence (Weinstein, 1967, p. 157). With little hope of winning a lawsuit, most injured workers

elected not to sue at all. David Brody has estimated that a steelworker's chances of recovering losses was less than two in one-hundred (1993, p. 92). Those who did sue and win usually received only small amounts of money, much of which was taken up by legal fees, after long delays and coerced settlements. In Michigan in 1910, 7,116 fatally and non-fatally injured workers for 466 industrial employers (not including mines and railroads) received an average of $10.91 in compensation and an additional $4.39 in medical benefits. Fatal accidents in these firms averaged a total recovery of $388.53 in compensation and relief (Rosner and Markowitz, 1987, p. 44).

Germany abandoned the employer's liability system in 1885, Austria-Hungary in 1897, France and Italy in 1898, and Great Britain in 1906. In Michigan, worker's compensation legislation ended the employer's liability system in 1913.

The contract mining system made the employer's defenses extremely easy to uphold. The newspaper and the mine inspector's reports provided constant reminders of the legal defenses that freed the employer from liability and the Bureau of Labor also added validity to these legal concepts. The following quotes reveal how easy it was to uphold the employers' defenses:

On August 2, 1884, the *Ishpeming Iron Agitator/Ore* wrote in an article about the republic mine:

> Mining is a dangerous vocation. In the prosecution of such work there are constantly hidden perils that the utmost caution cannot prevent. There is ground that has all the appearance of being solid when in reality it is not a death trap. Holes and fire, and skips jump the track, and miners themselves grow reckless of surrounding dangers and often seem to court accident. The Republic, while it had had a few bad cases this year, is in reality, no exception to mines in general. The management use (sic) all possible care to protect the men from dangerous places but

> cannot, no more than other mine overseers, prevent occasional accidents (p. 5).

On March 20, 1886, another editorial in the *Iron Agitator/Ore* expressed essentially the same viewpoint: "Just as long as mining is conducted sad fatalities will probably occur. We know the companies do all in their power to protect their employees from injury" (p. 5).

In 1891, a newspaper article stated: "Accidents are bound to happen in mining as long as the latter are wrought" (January 10, 1891, p. 5).

Death notices taken from the *Ishpeming Iron Agitator/Ore* also contain statements that help confirm the employer's legal defenses against liability for accidents. That the newspaper presented a strong company viewpoint to its readers has already been noted (see Appendix for additional quotes).

> John Barkle, an Englishman, was killed by a fall of rock at the Salisbury Mine. He had been warned about this several times that day (April 23, 1881).

> John F. Johnson, a Norwegian, and Peter Elwin, a Canadian, were both killed when they carelessly fell down the shaft at Champion Mine (July 30, 1881).

> John Roberts, an Englishman, who just got here was killed when he fell off the cage...they have naught to blame but their own carelessness (February 18, 1881).

> 3 men were killed at Winthrop Mine by a fall of rock. No one was responsible (October 2, 1886).

> Wm. Thomas was killed at the Lake Superior Mine by a loaded bucket of ore falling down the shaft...No one is to blame (March 2, 1889).

> Matt Sari was killed by a fall of ground at Cleveland #3...The accident was not due to the negligence of the company (October 3, 1891).

> Olaf Swanson, a miner at Nelson Mine, was killed instantly when he attempted to step into a bucket. He missed and fell 100 feet down the shaft. No one is to blame (February 27, 1892).
>
> Carl Mattson a miner on the third level of B Shaft of Cliff Shaft Mine was killed...he didn't look out for his own safety (January 19, 1901).

The Bureau of Labor report of 1896 also reinforced the legal defenses for the employer. The Bureau acknowledged the extraordinary dangers of mining and expressed the opinion that accidents happened in spite of the greatest care taken by the mining companies. Additionally, they assigned fault to the miner rather than to the mine owner or manager. "Mining is a dangerous vocation, and accidents continue to happen despite the greatest care that can be observed. Too often the accidents are due to carelessness of the men themselves..." (p. 332).

Again, in 1904 and 1909 the Bureau of Labor stressed the dangers of the industry. By placing most of the blame for accidents squarely on the miner, they lifted the burden of liability and the fear of lawsuits from the mining companies. The 21st Annual Report of the Bureau of Labor stated:

> The principal cause of accidents, fatal and otherwise, in the iron and copper mines, is carelessness on the part of the workmen themselves, just as is the case on the surface. Men can and do become habituated to any dangers common to their employment, too often to their undoing...(p. 105).

And from the 26th Annual Report:

> The underground workers of the iron and copper mines of Michigan each day face dangers that those employed in other vocation hardly know even by name. A great many of the accidents that occur, however, are due to the carelessness and ignorance of the workers themselves. Men who are surrounded by danger each day become hardened to them and finally, perhaps subconsciously, they think themselves immune. They take risks that are absolutely unnecessary, and which are discountenanced by the management of the mines...The mine horrors in

> which there is a wholesale slaughter are thus frequently due to the carelessness of the workers...the miner feels a zest in the constant race with death, and the narrower the escape the greater the interest in his work. For this reason, instead of scrupulously avoiding danger, he courts it, often with fatal results (pp. 44-45).

Analysis of mine inspector reports shows that as late as 1913 not only the mine inspector but also juries were helping to uphold the liability defenses of the employer.

From the Mine Inspector report of 1911:

> ...Samuel Dozzi was asphyxiated in the Smith Mine...this death was due to his own carelessness.
>
> ...Eugene Labeau came to his death by accident...This jury exonerates the officers of the Republic Iron Co. from all blame.
>
> The verdict of the jury was Frank Isaac Ruohoniemi came to his death by walking into a raise accidently...and that the company be exonerated from all blame.

From the Mine Inspector report of 1913:

> ...Was accidental death by his own neglect.
>
> ...Abram Waara came to his death by accident at the Republic Mine; the mine officials exempt from all blame.

While it is not possible to know today if the statements were made intentionally to help support the employer's liability defenses for the mining companies they were certainly sufficient to do so. No lawsuits were initiated as a result of the accidents and therefore they cost the company nothing. There was no legal stimulus for lowering the accident rate and the lack of responsibility on the part of the mining companies contributed to the high death rate in the first three decades of mining on the Marquette Iron Range.

Inability of the Majority of Employees to Speak English or Understand the Orders and Directions Given Them

The eventual success of the Marquette Iron Range lie in the nature and quality of the men involved in the mining venture. These men comprised two distinct groups: First, the entrepreneurs who planned, organized, and financed the fledgling industry. With heavy odds against their success any serious mistake in judgment would have brought failure. Second, the men who worked in the mines and hauled and loaded the ore. Without them the ore in the ground was useless and all of the organization, capital, and judgment in the world would not have produced any ore. These men only mined the ore but, in fact, built and populated the entire area. Their success along with the success of the mining venture lie in their own hands. Initially, nearly all of these men were immigrants. "The history of immigration to the Marquette Range is practically a history of the development of the iron mining industry within that territory" (p. 391), stated the Report of the U.S. Immigration Commission in 1911.

Although eventually the immigrants to the Marquette Range would represent more than 40 different countries, the first generation to arrive and to whom the iron range owes its initial development were the English, Irish, and French Canadians.

Most of the English and Irish immigrated to the Range between 1856 and 1885. The English came to the Upper Peninsula directly from the declining mines of Cornwall and were experienced miners. Only a small number of the Irish had experience in mining and most were employed as unskilled laborers. The French Canadians, who began arriving around 1870, did much of the surface work, particularly logging, to provide the huge quantity of timber used in the mines. By

1911, only 10% of the French Canadians employed around the mines were miners (*Immigrants in Industries*, 1911, p, 392).

Initially all work in the mines was done by hand. The output per man was low but the rate of compensation was high. In 1870, common labor received $1.80 per day and miners around $2.12 per day (Hatcher, 1950, p. 117). The high pay was a factor that attracted experienced men to the region.

In 1850 there were only 136 inhabitants in what was then Marquette County which embraced the entire iron range. The population grew steadily and by 1870 the county contained 14,235 people. Slightly over 60% of the entire population was foreign-born (Alanen, 1991, pp. 2, 4).

Because of the severe climate, summer was the only time of year that ore could be shipped from the region. As the demand for ore grew, more laborers were needed to load surplus stock during the shipping season. To fill this need, the Scandinavians were brought to the area in the spring of 1874. This was the beginning of the Swedish and Norwegian immigration to the range. After the shipping season, most of them went into the mines to work.

From 1880 to 1890 great progress was made in mining and handling the ore. About the middle of this period, mining machines were introduced which simplified mining and in addition to requiring less skill, greatly increased the output of the miner. In 1889 steam shovels were introduced to load ore from the stockpiles which reduced the number of laborers needed. However, as immigration from England and Ireland slowed and many experienced miners left the Marquette Range in pursuit of better opportunities, it became necessary to employ more new immigrant s who were

unskilled in mining. In 1883 the Finnish were brought to the Iron Range for the first time and initially were employed as laborers in loading ore from the stockpiles. The first Italians came to the Range around 1887 and were also employed as unskilled laborers. After the strike of 1895 many more English, Irish, and Scandinavians left the Range and each year after that there was in increase in the number of the more recent immigrant races employed; Belgians, Poles, Montenegrins, and Slovaks. A general idea of the changing nature of immigrants employed in the Marquette Range mines is shown in Table 7.

Table 7. Proportion of Various Nationalities Employed in 1898 and 1909 in a Representative Mining Co. on the Marquette Iron Range

Nationality	1898	1909
American	5.6	6.4
Scotch	.7	.9
Italian	5.3	17.9
French	7.8	5.9
German	.5	1.3
Irish	6.1	3.3
Finnish	17.0	24.9
Scandinavian	31.9	19.5
English	25.0	13.5
Polish	—	1.43
Austrian	—	2.07
Danish	—	1.03
Belgian	—	1.01
Montenegrin	—	.23
Total	100.0	100.0

Note: From *Immigrants in Industries*, 1911, p. 411.

Of the later immigrant groups, the Finns took the hardest jobs with the lowest pay in the mines, generally being employed as trammers. They would later become the nucleus of discontent among workers on the iron range and be instrumental in changing the longstanding amicable employer/employee relationship. By 1911 the Finns were employed in greater numbers than any race according to a 1911 study by the Immigration Department. Although extremely literate in their own language, 97.6% of the foreign-born Finns could read and write Finnish (see Table 8); only 60.5% could speak English. In fact, of all foreign-born employees, only 57.3% could speak English. All of the French Canadian surveyed spoke English. With this exception, the proportion of surveyed employees who spoke English was largest for the Swedes (89.4%) followed by the Slovaks (81.9%). The Croatians had the fewest English speakers, 32.3% (See Table 9).

Crystal Eastman found that from 1906 to 1910, the accident rate for non-English-speaking employees of the South Work Steel mill was double the average of the English-speaking employees. Almost one-quarter of the recent immigrants working in the mill were killed or injured each year, 3.273 in five years (Eastman, 1969, p. 14).

Death notices found in the *Ishpeming Iron Agitator/Ore* substantiate the fact that the language barrier was a factor in the high fatality rates before 1920.

> Giovanni, an Italian, was killed by rock falling from the hanging wall at the McComber Mine. He had been in the country 2 weeks (August 12, 1882).
>
> August Anderson was instantly killed when he stepped from a bucket at the surface and fell down the shaft at the Detroit Mine. He had worked at the mine only a few days and spoke no English (February 6, 1886).

Table 8. **Percent of Male Employees in Michigan Iron Ore Mines Who Read and Write, by Nationality.**

Nativity	Number Reporting	Percent Who Read	Percent Who Read and Write
Native born of native father, white	51	100.0	100.0
Native born of foreign father, father's country			
England	56	100.0	100.0
Sweden	46	100.0	100.0
Foreign born			
French-Canadian	44	86.4	86.4
Croatian	156	98.1	98.1
English	135	99.3	98.5
Finnish	656	98.8	97.6
Italian, North	529	94.7	94.5
Italian, South	54	90.7	87.0
Polish	385	85.2	84.4
Slovak	123	88.6	87.8
Slovenian	70	98.6	98.6
Swedish	160	100.0	99.4
Total	2,800	94.9	94.1
Total native born of foreign father	215	99.5	99.1
Total native born	268	99.6	99.3
Total foreign born	2,532	94.4	93.6

Note: From *Immigrants in Industries*, 1911, Table 152, p. 417.

In 1909, John Quine told the LSMI, "There can no question as to the necessity of rules and there seems to be no suitable method of reaching the men of various nationalities without printing these rules in numerous languages" (p. 73). And in 1912, William Conibear described the new Safety Department at CCI to the LSMI. He noted, "...the Company published a book of rules and regulations. The rules for the workers were printed in Finnish, Italian and Polish and each employee received a set of rules...

His signature for the same and agreement to study and live up to it is filed at the central office of the Company" (p. 96).

Table 9. Proportion of Foreign-born Male Employees of Non-English Speaking Nationalities Who Were Able to Speak English.

Nationality	Number Reporting	Percent Who Speak English
French Canadian	46	100.0
Croatian	158	32.3
Finnish	661	60.5
Italian, North	541	45.3
Italian, South	54	48.1
Polish	393	51.1
Slovak	127	81.9
Slovenian	65	50.8
Swedish	160	89.4
Total	2,408	57.3

Note: From *Immigrants in Industries*, 1911, Table 161, p. 426.

Obviously, at least one mining company on the Iron Range felt that the language barrier was a contributor to the high accident rate. As with experience, however, the fatality rate would be expected to decline rather slowly and uniformly over time as the men learned English and successive generations worked in the mines. No sudden ability to understand English can be associated with the period between 1912 and 1920. Additionally, the ethnicity of the population, including use of native tongue, was maintained well beyond 1920. In fact, even until the present time.

Carelessness or Recklessness on the Part of Many of the Men Employed

Although the claim of carelessness may have been used to protect the employers from liability for accidents, it must also be considered that perhaps the men actually were careless or reckless and that their behavior resulted in fatal accidents.

In her 1906 and 1907 study of workplace deaths in Allegheny County, Pennsylvania, Crystal Eastman attempted to determine, (1) to what extent carelessness of the worker entered into the causes of industrial accidents and additionally (2) what did "careless" mean in the analysis of workplace deaths. To Eastman fatalities resulted not from "carelessness," but "from a long list of human weaknesses, some common to us all, some resulting from special environments, some from which the man himself is not responsible, and some for which he is" (Eastman, 1969, p. 87).

To Eastman, "ignorance" covered a large share of the cases studied and she included in this category those who were "green" at their job—young boys and new immigrants with no experience in the job or environment in which they found themselves, and also those who spoke no English. In the case of the Marquette Iron Range, examples have already been given that reveal many fatalities involved young men, those who had been in the country only a short time, and those with no prior experience in mining.

Eastman found that "heedless," "inattentive," and "rash" were also synonyms that the dictionary applied to "carelessness." Among these terms she defined subtle but important differences when they were applied to the cause of fatal work accidents. For "heedlessness" she found no excuse. "Exasperating and hopeless, but fortunately rare"

act that no thinking man would do (p. 90). This notice from the *Iron Agitator/Ore* provides some insight into "heedlessness";

> At the 34 pit of Jackson Mine James Cavanagh opened the lid of a box of giant powder with a pipe in his mouth. Fire from the pipe dropped in, igniting the powder. 50 to 60 feet of the skip road was demolished and the pump connection to the pit was broken. Mr. Cavanagh died (June 17, 1882).

"Inattention" she found to be different, and not a fault of the worker. In a mine (or mill) the worker must always have an alert mind and keep his attention focused on his surroundings. Nothing must divert his attention from the dangers around him. However, there is much in such an environment that does weaken the power of attention—noise, heat, hard physical labor, tiredness, perhaps even illness—and accidents occur.

Eastman was also willing to forgive "rashness" or "recklessness," the deliberate failure to take precautions, as a fault of the worker. Feeling that the chief element here was haste, the desire of the worker to save some time, Eastman noted: "Their occupation involves constant necessary risk so unnecessary risk is inevitable but can hardly be considered a fault of the workman" (p. 93). Again the *Iron Agitator/Ore* provides an example:

> Five men at Cleveland Mine were blown into eternity without a moments warning...They were charging a hole with giant powder and couldn't find a wooden tamping rod long enough. They used a steel pipe and friction probably created a spark. Haste probably got the better of their judgment—they were experienced men...men grow careless from constant handling of (giant powder), as is natural with those in all kinds of dangerous employment (March 10, 1888).

The charge of "carelessness" was difficult to disprove. Coroner's records were meager and inquest testimony was given by the dead man's fellow workers who often

didn't even witness the accident, and/or the mine superintendent, captain, or shift boss. These men were employees of the company and it was in their best interest to clear themselves of responsibility. Many miners probably feared the loss of their job if they gave testimony implicating the company or their superiors. The safest thing to do, in all cases, was to blame the dead man.

Inquest testimonies form Mine Inspector reports show that in nearly all cases either the miner, through "his own carelessness" or "disobeying orders," or "no one" was to blame. In 321 Mine Inspector reports in which blame was assigned, seven stated that the company may have contributed to the fatalities and 314 stated that the worker was "careless," "disobedient," or that "no one was at fault."

Undoubtedly "carelessness" was the cause of many fatalities but it cannot, fairly, be attributed to a personal fault of the miner in all cases. When put in the correct perspective, it diminishes as the sole cause of fatal accidents. However, what was earlier interpreted as "carelessness" was very difficult to combat. A man cannot simply be made to be careful, his cooperation is necessary also and to achieve that cooperation a change in the entire philosophy of the mining venture was necessary. All participants in the mining business, from miners to owners, had to adopt a new viewpoint with regard to "carelessness" and when that happened fatal accidents decreased dramatically.

Technology: Old Technology That Had Become Unsafe or New Technology That Provided New and Unfamiliar Dangers

The contribution of technology, old or new, to the fatal accidents on the Marquette Iron Range is difficult to assess. The effects of technology on the mining fatality rate have been discussed by several authors. Mark Wyman, in *Hard Rock Epic:*

Western Miners and the Industrial Revolution, 1860-1910, argued that advances in technology increased the hazards of mining and therefore as advancements occurred, at least initially, an increase in fatality rate occurred (pp. 116-117). On the other hand, Ronald Brown, in *Hard-Rock Miners: The Intermountain West, 1860-1920*, argued that organizational structure and characteristics of the workers were more important factors and offset the technology fatality relationship (p. 81). Lankton and Martin analyzed the two views in terms of company size for underground fatalities in Michigan copper mines. Equating size with technological advancement (larger mines could afford more advanced technology) they found that the larger mines had a lower fatality rate than the smaller mines. If the relationship between size and technological advance is valid then advances in technology appear to have decreased the dangers of mining for the workers. However, it is also true that the larger mines may have had a different type or organizational structure that influenced the accident picture. Additionally, a better class of worker may have been attracted to the larger or more technologically advanced mines.

It is interesting to note that in 1912 the U.S. Bureau of Mines found that, taking all U.S. metal mines into consideration, the fatality rate in small mines was 7.05 per 1,000 men working a 300-day year. Whereas in larger mines it was 4.02 per 1,000 men working a 300-day year (Fay, 1913, p. 13).

It was found on the Marquette Range that individual mines, even of the largest companies did not always employ the same technology or use the same equipment, some were much better than others. As late as 1925, Charles Stakel, then superintendent of the North Lake district found marked differences among the mines;

> I also discovered that most of the equipment, tools, drills, motors, etc., underground were second hand discards from other mines. The Barnes-Hecker could not complete with other CCI mines for two reasons—poor equipment and rather poor man-power. Good miners never asked to be transferred to the Barnes-Hecker (p. 99).[7]

The mines of the Marquette Iron Range adopted new technologies very early due to pressures from new developments in Michigan and Minnesota. Steam power was introduced in 1878, electric lights in 1880, the caving method of mining in 1881, steam-powered machines in 1885, the steam shovel in 1889, and electric haulage in 1892. Also, after the Financial Panic of 1893 much consolidation of ownership took place. The mines became very capital intensive and new technology was rapidly introduced so that the Marquette Range mines could reduce costs and maintain a competitive advantage.

A very good place to look at changes in technology is in the machinery used in the mines (cages, skips, trams) and in electricity. The fatalities that occurred as electricity or various new pieces of machinery or electricity were introduced into the mines should reveal how advances in at least some technology affected the fatality rate. First, it must be assumed that, on the average, the introduction of new technologies into the mines can be equated with advances in time. Tramming, for example, changed

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[7]The Barnes-Hecker Mine was an ill-fated operation and the site of the most tragic accident on the Marquette Iron Range. On November 3, 1926 a cave-in occurred more than 700 feet below the surface when miners blasted into a vug or open fissure on the second sub-level below the first level. In a period of 15 minutes the workings of the entire mine were filled with sand and water to a point about 100 feet from the surface. Wilfred Wills was the only survivor of this disaster in which 51 men died. The Barnes-Hecker was not included in the fatality data for this research because it was a statistical oddity and as such would have had too great of an influence on the data. The fatal accidents on the Marquette Range were random occurrences, usually 1 or 2 at a time, and only these "normal" accidents were used in the data from which the conclusions were drawn.

over time from hand tramming, to mules, to endless cables, to electric motors over time. Examination of Table 10 shows that in the first four decades of mining (1880-1920) the overall trend was an increase in fatalities related to machinery. The exception is fatalities related to cages which showed a marked decrease in the fourth decade (1910-1919). If the assumption made above is valid, then it can be concluded from this data that advances in technology related to machinery increased the dangers of the workplace and therefore the fatality rate. There are not enough fatalities due to the use of electricity to establish a trend. However, the single electrocution in the first four decades did occur early in the electrification of the mines and might signify unfamiliarity with the technology.

The sudden decrease in fatalities due to machinery in 1920 cannot be accounted for by any significant advances in the technology of mining machinery. New equipment had been introduced from the 1880s on and, as in the case of the Barnes-Hecker, old equipment was still in use. After 1920, modern technology and machinery continued to be introduced into the mines as it was developed and probably old machinery remained in use also. However, there are no trends with respect to fatalities related to machinery that can be observed in the data after 1920.

Table 10. Causes of Fatalities, By Decade, in Underground Mines on the Marquette Iron Range; 1880-1979.

Decade	Fire	Explosion	Falling Rock	Falling Objects	Runs of Ore	Cage Acc.	Skip Acc.	Tram Acc.	Falls	Electro-cution	Other	Total
1880s	2	25	109	10	—	20		10	47	0	13	236
1890s	0	9	63	6	6	10	12	5	29	1	5	146
1900s	0	27	69	4	21	19	13	12	27	0	7	199
1910s	10	7	76	4	8	6	16	13	17	0	5	162
1920s	0	1	23	2	1	3	0	4	7	0	0	41
1930s	0	3	11	2	1	0	0	3	3	1	1	25
1940s	0	2	18	4	2	1	0	4	6	0	2	39
1950s	0	3	10	0	0	0	0	4	2	0	3	22
1960s	0	2	3	1	1	0	0	2	0	0	0	9
1970s	0	0	0	0	1	0	0	0	0	0	0	1
Total	12	79	382	33	41	49	51	57	138	2	36	880

From the data in Table 10, it can be concluded that technology, as represented by machinery, did contribute to the high fatality rate before 1920. However, it is not possible to assign fault to either old or new technology without reservation. The slight increase in fatality rate related to machinery throughout the first four decades of mining is a possible indicator that new technology may have increased the hazards of mining. It must be remembered, however, that new technology allowed the use of less skilled workers, a factor which also contributed to the high fatality rate.

The fatal accidents that occurred in specific mines were also analyzed with respect to production for the first four decades of mining (see Table 11). In this case, production was used as a proxy of mine size and technological advancement; the biggest producers were the largest mines with the most advanced technology. The mines were ranked according to the number of tons produced per fatality. It can be seen from the data that only once did the largest producer rank first in the number of tons produced per fatality. The remainder of the time the largest producer ranked second or lower. Several factors could account for this: (1) the smaller producers may have had a smaller workforce and there was, therefore, less exposure of the miners to the hazards of the job, (2) even though small, a producer may have used more modern technology than a larger producer, (3) the smaller producers may have employed a more highly skilled workforce, (4) as suggested by Brown, the management of a smaller producer may have had something in its organizational structure that promoted safety.

Table 11. **Ranking of Mine Production vs. Number of Fatal Accidents in the Underground Mines on the Marquette Iron Range, By Decade; 1879-1919.**

1879-1889					
Lake Superior	2,667,951	17	156,927	T/D	1
Republic	2,505,117	22	113,869		2
Champion	1,673,620	19	88,085		7
Lake Angeline	1,073,488	11	97,590		4
Michigamme	492,527	5	98,505		3
Cambria	486,073	6	81,012		9
Salibury	467,110	6	77,852		10
Milwaukee	350,888	4	87,722		8
Barnum	275,159	3	91,720		6
Lillie	186,570	2	93,285		5
1890-1899					
CCI	4,559,427	34	134,101	T/D	8
Lake Superior	4,216,196	24	168,648		6
Lake Angeline	3,579,040	12	298,253		2
Queen	2,816,358	14	201,168		4
Republic	1,452,223	17	85,424		9
Champion	1,309,055	22	54,502		12
Negaunee	1,264,013	6	201,669		3
Winthrop	984,856	6	164,143		7
Lillie	909,438	5	181,887		5
Cambria	709,176	1	709,176		1
Davis	77,867	1	77,867		10
Platt	73,844	1	73,844		11
1900-1909					
CCI	9,366,577	35	267,616	T/D	2
Lake Superior	6,021,254	37	162,737		4
Lake Angeline	3,175,643	6	529,273		1
Negaunee	2,169,233	27	80,342		8
Hart Ford	1,751,323	11	159,211		5
Republic	1,415,344	12	117,945		7
Cambria	819,691	4	204,923		3
Champion	791,618	15	52,745		10
Lillie	627,905	5	125,581		6
Maag	220,611	4	55,153		9
1910-1919					
CCI	18,005,803	66	272,815		2
Republic	1,977,952	19	104,103		5
Oliver	1,922,901	13	147,915		3
Am. Boston	1,396,414	16	87,275		7
J&L	1,089,747	8	136,218		4
Lake Angeline	814,439	1	814,439		1
Breitung	666,872	6	111,145		6

Although information was limited, the Lake Angeline Mine was studied in as much detail as possible to try to assess the above factors. The Lake Angeline Mine was not the largest mine on the Range nor was it owned by one of the larger corporations. However, this mine consistently had high production per fatality for the first four decades of mining (rank = 4, 2, 1, 1, respectively). The Lake Angeline Mine was one of the first on the Marquette Range to introduce electric haulage and have electric lighting underground. Additionally, by 1891 this mine was using the caving method of mining, the safest of the methods (*Ishpeming Iron Agitator/Ore*, September 12, 1891). This suggests that new technology not only increased production but also decreased the hazards of mining for the individual worker. Even more significant is the fact that in October of 1892 Lake Angeline Mine introduced the 8-hour shift for the first time in the history of the region (*Ishpeming Iron Agitator/Ore*, October 1, 1892). This was tried for three months and was retained after the trial period because it was found that the production per man was larger than ever before in the history of the property (*Ishpeming Iron Agitator/Ore*, December 24, 1892). This suggests that Brown was correct when he stated that technology was not as important as the organization of the mine and the characteristics of individual workmen when it came to reducing fatal accidents.

Unavoidable Acts of God or Accidents that Cannot be Prevented in Any Way

Because mining was such an inherently dangerous occupation, many miners and mine managers felt that fatal accidents could not be prevented. A March 20, 1886, editorial in the *Ishpeming Iron Agitator/Ore* stated; "There are a hundred ways whereby a miner may meet his death. His occupation is one of constant peril and what

is worse there seems to be no remedy for him." This idea was reinforced by numerous notices of fatalities such as this one from the 1887 *Iron Agitator/Ore*; "A miner, Thomas Brewer, was blown to atoms at the Lake Angeline Mine by giant powder he was carrying...Maybe his candle set it off, don't know. This was an unfortunate accident that can't be prevented" (December 24, 1887).

In January 1891, an article entitled "Mine Accidents" in the *Ishpeming Iron Ore* noted:

> ...for it (the mining trade) certainly is dangerous no matter how great care may be exercised by miners and companies. Often when the hanging appears to be the firmest there will come a treacherous slip that may bring death or disabling injury, a thunderbolt out of a clear sky, as it were; dynamite sometimes fails to explode when the fuse is lighted and the failure of the men to know this has led to many deaths; skips have been precipitated to the bottom of the shaft by the breaking of a rope that everyone thought solid and strong, and a misstep upon a ladder may be the means of serious injury (January 10, 1891).

The Mine Inspector's reports also contributed to the concept of the unavoidable accident. Following a fatal accident the findings of the Mine Inspector or the coroner's jury were routinely reported as "accidental death," "accidental," "no blame attached to anyone," or "an unavoidable accident" (from 1907 and 1905 Mine Inspector's reports).

The concept of the "unavoidable accident" contributed to the high fatality rate because if it was felt that fatal accidents were something that could not be prevented then no one had to do anything about them. However, to consider these accidents as "unavoidable" or perhaps "acts of God" only relieved those who could control the occurrence of the accidents of their responsibility.

It can be seen from the data discussed how the eight factors listed contributed to the high fatality rate in the early decades of mining on the Marquette Range. The next

chapter will focus on how the factors changed in order to lower the fatality rate and the stimuli for those changes.

CHAPTER 9

THE INFLUENCE OF NATIONAL EVENTS ON THE MARQUETTE IRON RANGE FATALITIES: STIMULI FOR CHANGE

Introduction

While everything was proceeding well for the Iron Range companies, in spite of the high fatality rate among the miners, many changes were taking place that were to have a great impact on the concept of handling fatal accidents in the mines. These changes were impelled along by events that were occurring not on the Marquette Iron Range, but elsewhere in the country but would direct the mining company philosophy toward the idea of reducing fatalities. These changes would also stimulate an interest by the mining companies in all aspects of the safety of their employees. Significantly, these changes began to appear in the 1890s and the first one-and-a-half decades of the 1900 when the fatality rates were the highest experienced on the iron range.

Between 1880 and the first decade of the 1900s, violent strikes, rising unionism, changes in employers' liability, the threat of Socialism and Populism, economics, and anti-trust laws combined to change the way in which companies viewed work accidents. Work safety began to improve significantly and became a defined movement within large corporations, namely the steel corporations. The mines, closely associated with the steel industry, were included in this movement. Each of the above factors was evaluated in terms of how it affected the eight conditions to which the high fatality rate was attributed in an attempt to define the most important factors involved in deceasing the fatality rate and the stimuli for change.

The Role of Economics of the Iron Ore Industry

Faced with rising costs, as the mines went deeper and deeper, and increasing competition from the cheaply obtainable ores of the Mesabi Range, the Marquette mining corporations were forced to try to control fixed costs while increasing production. Also, after the Panic of 1893 the price of ore dropped sharply at the mills. The mining companies had to produce more ore at a lower cost in order to make a profit.

The greatest expense on the Marquette Range was wages. William Mather told the LSMI in 1898:

> Now, the main factor in producing ore is labor, averaging about 70% of the total cost on cars at the mines. Therefore, to operate steadily and economically it is of importance to understand what conditions will give a sufficiency of efficient and competent men, and how to keep those we have now, and how to make them more capable. Some of the conditions are good health, intelligence, contentment, and industry, and these should be encouraged while sickness, accidents, ignorance, and restlessness should be overcome as soon as possible. Relief and pension funds, health service, good housing, workingmen's life insurance associations, co-operative distribution of stores, schools of all kinds, schemes of recreation, and other benefits have been fostered in a wonderful degree by some employers principally in Europe to further the good and prevent the bad conditions above named (p. 12).

While Mather concluded that the condition of people in the Lake Superior mining region was far above the average for other mining regions and "many of our employers are alive to their responsibilities," his survey of operating company accident relief funds showed that the main interest of most employers was saving money for themselves. Contributions for hospital fees were paid mainly by the employee but administered by the employer and more revealing, all of the Marquette Range mines

required a formal release of company liability upon payment from the fund in case of accident or death.

Although, personally, Mather's concern may have been humanitarian it appears that he was fully aware of the fact that only profit would catch the interest of most employers. With respect to the cost of illness or injury to the employer, Mather had done a careful accounting;

> For example, if the average product for the whole force per man per day is 3 tons for 10 hours, and his wages are $2.00, and if each ton nets a profit of $0.25, then for each hours work he gets $0.20 and produces about one-third of a ton of ore which nets a profit of about $0.08. Now then, if he gets paid by the day, and owing to some of these conditions he only gives 9 hours of good work, you are losing $0.08 a day. Work this out on a basis of 500 to 1,000 men and the result will be a respectable sum. Remember, also, that every ton of daily product lost increases the fixed charge cost on the remainder of the product (LSMI, 1898, p. 18).

Still appealing to the economic side of better working conditions Mather continued;

> The above thoughts have been set forth solely on the supposition that it might pay mining companies and employers in these days of large operation to pursue more thoroughly some of these methods from purely a selfish and pecuniary point of view (LSMI, 1898, p. 19).

Mather himself, however, appeared to feel more than a monetary obligation;

> I would not like to close, however, without bearing witness to the feeling that upon us who have been more favored by education and opportunity for attaining success in the struggle of life than has been vouchsafed to many of our employees, there rests that obligation so well expressed by the words 'noblesse oblige' (LSMI, 1898, p. 20).

In an attempt to fulfill their obligations and provide better conditions for their employees the mining companies became very paternalistic. Paternalism was not new to the mining regions of the Upper Peninsula and it had many faces. At first, due to the nearly complete isolation of the area, it was necessary for the companies to provide

living quarters and a few other essentials in order to attract and hold workers. Later as the amenities provided became more lavish—theaters, libraries, YMCAs, pools and bathing facilities—paternalism was promoted as an open-handed goodwill gesture. The main benefits it provided, however, went to the companies. Paternalism gave the companies a good image with the public and helped attract and hold a much better class of worker. Its cost to the companies was far outweighed by the economic efficiency provided.

The Effect of Strikes

Violent strikes, nearly 22,000 of them between 1880 and 1900, affected more than 17,000 businesses (Hanger, 1904, p. 1099). Particularly significant to the Marquette Iron Range was what was happening in the steel industry and in other mining areas.

In 1872, Michigan's copper district experienced its first major strike which followed some local activity of members of the International Workingmen's Association (Thurner, 1984, p. 33). Around 1886 the Knights of Labor became active in the Copper Country and after the Haymarket Square Riot in Chicago, stemming from a strike by iron molders at McCormick Harvester, mine operators in that area became particularly leery of unions. Alexander Agassi, president of Calumet and Hecla, the largest copper mining company, pronounced; "Nothing more thoroughly un-American in practice and principle can well be conceived of then trade unionism" (Thurner, 1984, p. 33). The copper companies, especially Calumet and Hecla, became devoted to keeping the unions out of their mines.

Although experiencing little organized union activity themselves, the managers of the Marquette Range iron ore mines were very cognizant of the labor trouble in the Copper Country as well as that in the iron ore shipping industry. Union activity in the lakes shipping industry was a source of longstanding conflict. The first organization of lakes sailors occurred in 1863 and by 1880 the vessel owners had decided to retaliate against the growing union movement. They formed the Cleveland Vessel Owner's Association whose main goal was to destroy the unions. However, largely due to unpleasant working conditions on the steamboats, the unions gained strength. While many unions battled to represent the men and negotiate contracts, the Pittsburgh Steamship Company (formed in 1901, a subsidiary of U.S. Steel) came under the leadership of Harry Coulby who quickly went to battle with the unions; "Mr. Coulby has never been noted for his tact, and it is said that the labor unions will find a hearty warrior when they come up against him," observed the *Duluth Evening Herald* in 1904 (Miller, 1999, p. 54). Coulby quickly had the unions on the defensive, but not until many weeks of bitter strikes had ensued.

Mine managers on the Iron Range also desired to suppress union activity and did so by discouraging, but not forbidding, membership activities. After some short, minor strikes in 1874, 1883, and 1890, mainly for higher wages, the Bureau of Labor and Industrial Statistics commented about the Iron Range;

> No region was more prosperous or contented, and the almost entire absence of strikes or labor dissentions is conclusive proof that the relation between employer and employe (sic) was agreeable even unto cordiality. No other region in the country employing a like amount of labor can show a better record in this respect (1894, p. 427).

However, the relatively high wages that had kept peace in the Iron Country disappeared on the heels of the Panic of 1893. In 1894 there was a six-week strike on the Gogebic Range and in 1895 the Marquette Iron Range experienced the biggest strike in its history. Area miners organized a local, independent union to conduct operations, the Marquette Area Mine Worker's Union, which grew rapidly. The mining companies requested the Governor to call out the National Guard and the strike collapsed after nine weeks.

This strike was non-violent and not over working conditions, but over wages. The miners wanted a wage increase, standard wages paid in all mines, and union recognition (Brinks, 1966, p. 298). Although non-violent the strike clearly represented increasing conflict between employers and employees and convinced corporate mine management that steps had to be taken to restore good relationships between labor and management.

The Marquette Iron Range strike of 1895 closely followed the 1892 Pennsylvania Homestead Strike of the Homestead Steel Company owned by Andrew Carnegie and the great Pullman Strike of 1894. Never before had labor and capital been engaged in such organized private warfare as developed at Homestead nor had the public ever become more alarmed over the dangers of industrial strife than during the Pullman strike. The general discontent with their lot in life among industrial workers was reflected in these strikes which occurred in years of depression, unemployment, low wags, and some of the worst working conditions in the industrialized world. The Homestead Strike had to be especially alarming to the companies that operated mines

on the Marquette Range because their mines supplied ore directly to the Carnegie steel mills.

Metal miners at Coeur d'Alene Idaho and coal miners in Tennessee also provided a number of violent strikes that undoubtedly drew the attention of the Marquette Range mining companies. The iron mining corporations recognized that what was happening in the isolated Upper Peninsula was a reflection of what was happening throughout the country and hoped to alleviate the situation by improving working conditions and reducing fatal and non-fatal accidents.

Although, today, the unions are usually credited with improving working conditions in the mines, making them much safer by reducing the hazard of the job, this is true only in a negative sense. Initially it was the threat of unionization rather than the unions themselves that resulted in a reduction of work hazards and therefore fatal accidents. There was no group that hated unions more than the iron, steel, and copper industry leaders. "We must make it certain that men in our employ are treated as well as, if not a little better than, those who are working for people who deal and contract with unions," stated U.S. Steel's Elbert Gary (Wilhelm, 1914, p. 1007). The bitter steel strike of 1919 undoubtedly increased the efforts of the companies to improve working conditions and relationships with their employees.

The Role of National Politics and Legislation

Added to the woes of the iron and steel industry was the wave of Populism sweeping the country. Rooted in unrest among the nation's farmers, Populism also strongly appealed to miners of metal ores and coal. The movement was a threat to corporations because it challenged the whole concept of government by organized

wealth. The People's or Populist party, formally organized in 1892, accepted as its basic premise the idea that wealth belonged to those who produced it and strove to recover for workers that political power that was felt to have been usurped by big business. This was just the opposite of what was happening in the iron mines as jobs evaporated and wage rates sank in the Depression of 1893.

In addition to the popular political movement, legislation also provided a stimulus for change. In 1890, the Sherman Anti-Trust Act was passed. This act outlawed trusts, combinations of large companies into one that could control an entire market. Examples of such combinations were Standard Oil in 1891, U.S. Steel in 1901, International Harvester in 1902, and on a somewhat smaller scale Cleveland Cliffs Iron Company in 1891. The anti-trust legislation was toothless but still the trusts that formed wanted to make an attractive image to dispel public apprehension.

The *Ishpeming Iron Agitator/Ore* tried to allay local distrust of the newly formed CCI in 1891. An editorial entitled "A Corporation: Some Idea As To What The Monster Is, A Brief Description," after alluding to, "A long time ago...when there was nothing but a few bands of roving Indians, many red deer, and a few black crows," went on to describe the men who were essential to the utilization of the rich iron ore deposits;

> Hundreds of thousands of dollars were expended in getting the mines started, and, like the men of the copper district, they were nonresidents of Negaunee and Ishpeming, for the reason that there were no capitalist residents of the wilderness. They provided the money, bought large tracts of land, and paved the way for others to follow them. By their pluck and money they have secured to the country one of its most important industries...It was hard work and expensive...but success did come, finally, and the path was opened for other companies, and for the miner and the merchants...It took millions of dollars to prepare for this

> and the corporation had to be formed to make it possible...That mining corporations can make money and conduct a business that permits them to pay good wages, and promptly, is of greatest benefit to the miner, merchant, and all concerned...There is nothing so dangerous in the Corporation (March 28, 1891).

With the support of such favorable journalism to improve their image, the mining companies also tried to give the appearance of great social responsibility. One solution offered by some was welfare capitalism. This was exhibited by the development of extensive paternalism in the Marquette iron district. Company-built homes, hospitals, libraries, schools, recreation centers, and even model towns such as Gwinn dotted the area. Paternalism, however, was not an openhanded gesture of goodwill. For the corporations, it had a specific purpose; to appease the workers and keep the unions out. As costs rose and prices declined, the corporations abandoned paternalism quickly. In the long run, it served to alienate certain factions among the workers more than it appeased them.

The Role of the Legal System

Another factor stimulated interest in accident reduction and better working conditions. This was the fact that the longstanding employer liability laws were failing to protect companies from lawsuits over worker deaths and injuries. By 1907, limitations of employer liability laws were instituted in 26 states and while many judges threw personal injury cases out of court, new liberal judges were letting these cases go to juries. Jurors began to overlook the law and the facts if they got in the way of fairness, and more and more often sided with the injured worker. Additionally, attorneys were appearing in the mining locations who sought out injury (or fatality)

cases and urged the worker or his spouse to sue rather than accept out-of-court settlements from the companies.

Out-of-court settlements typically cost the companies between $250 to $2,000. For example, in 1904, Olinto Rocchi settled with Quincy Copper Mining Company for $1,000 after losing both legs below the knee in a skip riding accident (Lankton, 1991, p. 136). On the Iron range the settlements were even lower unless the case went to court or a lawyer forced a larger settlement. A woman from the iron country recounted the following;

> Suppose you lost your husband, lost your son. You go ask the company, 'How much you gonna give me for my son? You killed him.' Maybe a hundred dollars. Maybe a couple hundred dollars. You don't want that, you get nothing. But then people started getting smart. They find a lawyer from Minnesota. In my day I remember that. This fella, the lawyer, was for the worker and not for the company. Because lots of lawyer, the company they buy the man. They give him a thousand, two thousand dollars and you get nothing. But this lawyer, the working man always profit. One man lost an eye. The lawyer make him wise. He say, 'listen, how much the company gonna give you for that eye?' 'Couple hundred dollars.' 'Couple hundred dollars: Please don't sign to pay me. I call that my pay.' So they sued the company and the time come when they had to go to court, have a trial. So he said, 'How much do you want to pay that man?' The company told him, 'Two hundred, three hundred.' 'You want to pay the man seven thousand dollars?' 'Oh, my God, no, that's too much money.' The lawyer took out his purse, took out seven thousand dollars, put him on the table in court. He said, 'Come here.' To the company man, see...He pulled a little knife out of his pocket. 'That's your seven thousand dollars. Come on, I'll pull one eye off.' 'Oh,no,oh,no!' 'Well, he said, 'pay that man. He lost his eye. You no want to lose no eye for seven thousand dollars. That poor fella don't either, so you pay him.' So he had to pay seven thousand dollars. You bet (Black Rock and Roses, 1975, no pagination).

Sympathetic juries often granted an injured employee or his spouse large awards also. These awards created unpredictable and often very large expenses for the companies involved. As early as 1886, a verdict of $5,000 against Cleveland Iron

Company was granted in the death of a miner named Husby (*Ishpeming Iron Agitator/Ore*, December 25, 1986). And in 1912, a jury gave a verdict against Michigan's Quincy Copper Mining Company of $17,500 in a non-fatal accident suit (Lankton, 1991, p. 131). Court decisions began to swing in the worker's favor and employers began, for the first time, to bear the burden of industrial accidents.

Illinois appellate court decisions between 1905 and 1910 were two to one in favor of injured workers (Castrovinci, 1976, p. 67). In 1908 and 1909, the Minnesota supreme court favored the injured worker in 73% of its decisions, while supreme courts in Pennsylvania, Michigan, Wisconsin, and Iowa recorded 43%, 46%, 53%, and 63% favorable decisions respectively (Asher, 1974, p. 422-423). In Ohio, from 1906 to 1908, 80% of the verdicts in non-fatal accident cases were decided in favor of the injured worker (Rosner and Markowitz, 1987, p. xii).

These rewards greatly increased employer's liability insurance. Premiums paid by employers rose rapidly going from $103,132 in 1887 to $7,129,444 in 1900, rising to $15,767,818 in 1905, and almost doubling in the next three years to $27,938,311 in 1908. In 1911 employers' liability insurance premiums reached $35 million nationwide. States varied in the increase of their employers' liability insurance burden on employers depending on their legal practices, legal environment, industrial mix, and industrial growth. In Massachusetts, between 1901 and 1910 premiums rose 140%. Figures from New York, Minnesota, and Washington show premium increases of 355%, 410%, and 885% respectively (Rosner and Markowitz, 1987). In Minnesota, increases in employer liability losses were so rapid that premiums could not keep pace. Between 1903 and 1907, Minnesota employers' liability insurers paid out 58% of the premiums.

However, in 1908 the figure jumped to 68% and in 1909 rose to 78% (Asher, 1974, pp. 422-423).

At the LSMI meeting in 1909, Murray M. Duncan discussed the unjustness of the employer liability system in the U.S. He noted that the system placed the entire burden of accidents on the employee and, furthermore, that it had been discarded in every industrial country in the world except in the United States and Canada. "Such a system is throughly bad, legally and morally. It creates distrust of the courts and constant irritation between employer and employee" (p. 48).

It is clear from Duncan's paper that underlying the new moral concern about the legal system and compensation for accidents was an economic consideration. Economy, holding down the costs of the mining operation to the lowest possible level, was the real motivation for concern and although veiled, it can be seen that the big problem for the companies with injuries to their employees was not the "unjustness of the employer liability system" but the unknown amount they might have to compensate the employee upon an unfavorable jury decision. "I wish the emphasize the point that compensation to the employee, rather than punishment of the employer, is the correct basis for whatever system is adopted" (Duncan, 1909, p. 50), urged Duncan, speaking in favor of a uniform system for compensation for accidents.

> I know that the large employers of labor are earnestly striving to protect and safeguard their employees from injuries. The theory of negligence upon which verdicts are rendered is in most cases a mere legal fiction. Juries act upon sympathetic motives rather than because of any conviction that the employer has been really negligent (p. 50).

It can also be seen from Duncan's paper that the iron ore mining industries were in favor of a system of workmen's compensation, which was yet to become law in Michigan. Duncan stated:

> But in spite of all precaution, accidents and even deaths are unavoidable in every industry. The principle of compensation is that each industry shall pay in such cases some just and adequate amount, not as damages collected from some alleged negligent employer, but as a method of fairly distributing the extraordinary risks of civilization (pp. 50-51).

Although such a system would ensure that the injured party would receive compensation without controversy, which Duncan deemed "a matter of common justice," it is apparent that such a system would be far more beneficial to the employer. It would keep the cost per accident low for the individual employer and eliminate the possibility of an unpredictably large jury award to the injured party. "Such payments," Duncan concluded, "become a part of the cost of production, like expenditures for broken down or worn out machinery, and if required by law, so as to place all producers on the same basis, would not be detrimental to the employer (p. 51).

In 1912 the State of Michigan enacted a Workmen's Compensation Law which was the result of a movement initiated by a member of the LSMI (Conibear, 1912, p. 95). This law limited the liability of the mining companies (and others) for injuries to employees to that prescribed by the law and was fully supported by them. The new compensation law furthered efforts to reduce accidents because the fewer accidents that had to be compensated the lower the rate companies paid for the compensation insurance.

The factors presented here had the cumulative effect of prodding the companies to improve working conditions for their employees. A major stimulus was provided by

the loss of protection from existing employer liability laws. The companies lost their ability to avoid compensation for accidents and it became necessary to protect employees from injury or death in order to protect profit. The companies now had to consider how the remaining conditions that resulted in fatal accidents could be changed to lower the accident rate.

CHAPTER 10

THE SAFETY FIRST MOVEMENT ON THE MARQUETTE IRON RANGE

Introduction

As the 20th century began there seemed to be no abatement in the industrial accident rate. People began to compare the workplace with war as coal mine cave-ins and explosions, blast furnace, railroad, and manufacturing accidents claimed thousands of workers' lives. From 1900 to 1905, for example, the Marquette Iron Range recorded some of its highest death rates; 4.83, 7.43, 6.52, 4.44, and 5.27 respectively.

A group of journalists and writers of this period, called the "muckrakers," vividly portrayed the dangers of the workplace. An editorial in one popular magazine, *The Outlook*, demanded the extent of industrial accidents be documented; "in order that the people of the United States may face the situation and understand how cheap human life has become under American conditions" (Slaughter By Accident, October 8, 1904, p. 359).

Perhaps most significant for the iron miners on the Marquette Range was a 1904 article in *Everybody's Magazine* by muckraker William Hard who described working conditions in the south Chicago plant of U.S. Steel. *Everybody's* three million readers were appalled by Hard's description of men who dropped into vats of molten metal or were showered with steel by sudden explosions in the blast furnaces and the failure of the company to provide safeguards to protect their workers (Hard, 1907, pp. 579-592). This article and others similar to it served not only to unveil the horrid working

conditions of labor to the public, but also turned public opinion against the huge steel corporations. The steel industry was pushed to put forth great effort to counter these attacks by improving working and living conditions for their employees. In fact, John Fitch, another popular writer of the period, suggested that Hard's article spurred U.S. Steel to begin a campaign to improve safety and reduce accidents (Fitch, 1911, p. 1149). Since the iron ore mines and the steel companies were directly linked by product as well as control, improvements were seen in working conditions in the mines also.

Origins of the Safety First Movement

Although most safety "experts" claimed that worker carelessness was responsible for 70 to 80% of all injuries, many also understood that to encourage safer work habits the workplace had to be made safe also. Therefore, a central feature of the new safety campaigns had to be their integration into a management function. The incorporation of accident prevention and work safety as a responsibility of management marked the beginning of what is known today as the Safety Movement or Safety First Movement. At this time work accidents ceased being viewed as routine matters of individual carelessness and instead were seen as reflections of management failure. Companies took the responsibility for the safety of their employees.

Management interest was essential to reducing the fatal accident rate on the Marquette Iron Range. Although carelessness or lack of knowledge on the part of the miners themselves may have been an important cause of accidents, there was not much of a way to change this until accident reduction became a management priority. In 1913 E. B. Wilson, editor of the Colliery Engineer, told the LSMI: "It is undoubtedly true that the number of accidents may be decreased by united efforts to teach the miners to

care for themselves and by using strict disciplinary measures to regulate carelessness and evasion of rules" (Wilson, 1913, p. 111).

Safety First generated rules for everyone in every phase of mining the ore and management enforcement made the rules effective. The movement became more and more widely discussed. There was an attempt to spread the idea to everyone because it appeared to have a positive effect on accident reduction.

What is considered to be the first modern safety organization was developed at the south Chicago works of Illinois Steel by Robert J. Young between 1906 and 1908 (Aldrich, 1997). Young, who was manager of the plant's department of safety and relief, organized committees of workers, foremen, and "important officials" to make inspections, investigate accidents, and make recommendations for improvements in work conditions and practices.

In 1908, U.S. Steel adopted Young's structure and pioneered its own safety program. As the world's largest corporation, U.S. Steel had been subject to almost continuous public attack since it was formed in 1901 and needed to improve its image. In March 1908, Chairman of the Board Elbert H. Gary told the company's managers, "Any requisition which is made for the expenditure of money to install equipment to protect our people will be honored" (Aldrich, 1997, p. 91).

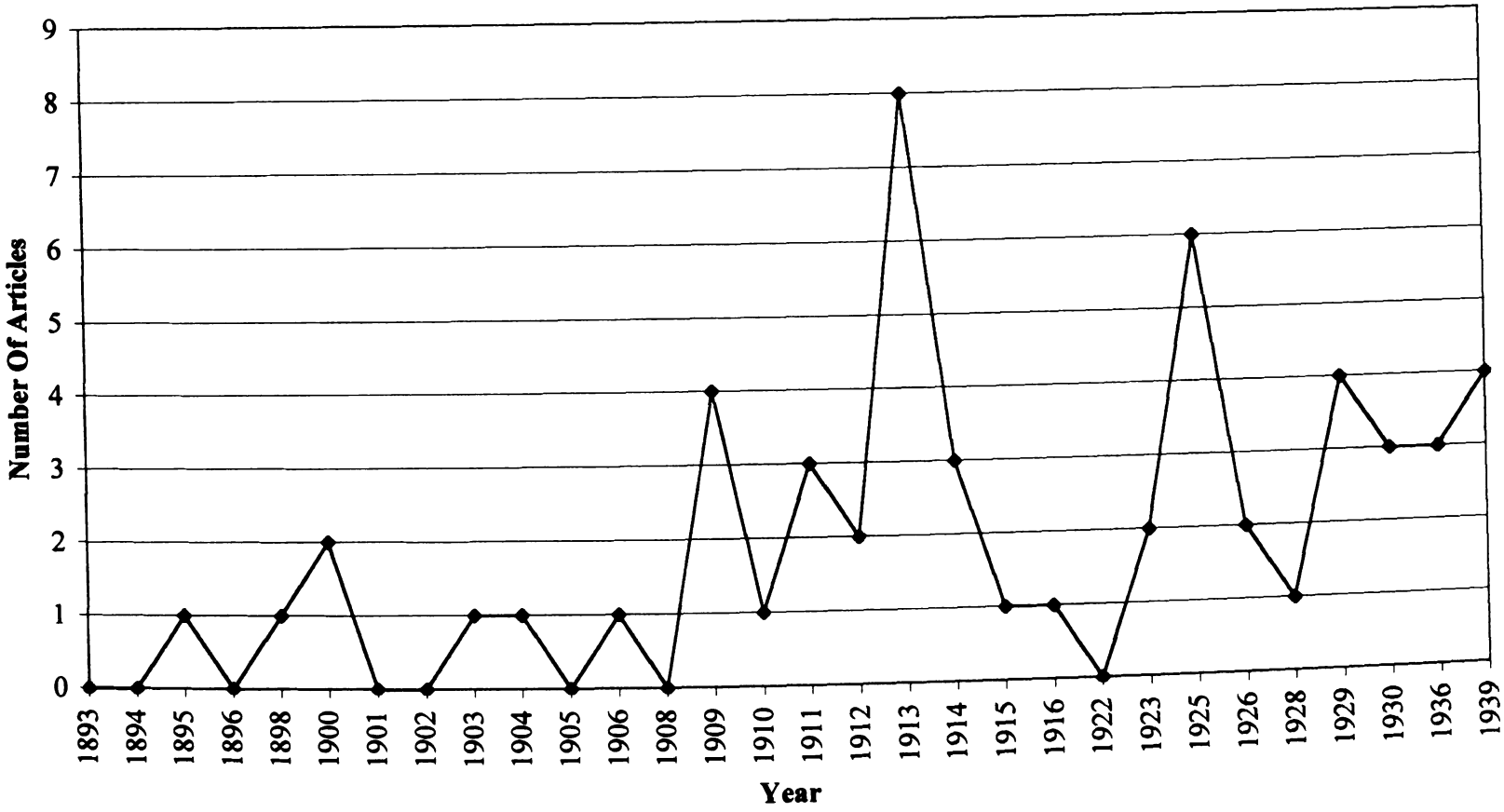
By 1900 most of the mining companies on the Marquette Iron Range (except CCI) were owned by the large steel companies and therefore quickly began to organize safety programs also. W. H. Moulton of Ishpeming told the LSMI in 1909, "Special commendation should be given to the Steel Corporation for the study that they have given to promote the safety of its employees" (p. 93). Oliver Mining Company, a U.S.

Steel subsidiary, set up the first safety organization of the Marquette Range in 1910. CCI, the only independent company on the Range, followed in 1911.

Literature Analysis of Articles Pertaining to Safety in the LSMI Proceedings

The importance of safety and the spread of the Safety Movement throughout the iron ore mining industry can be followed by analyzing the LSMI proceedings. The LSMI began to meet and publish its proceedings in 1893. From then until 1900 four papers (9.7% of the total number of papers) pertaining to some aspect of safe working conditions and/or accident reduction were published. In the next decade safety, and the cause and method of reduction of accidents, was the topic of eight papers (8.8% of the papers for the decade) and from 1911 to 1917 the number jumped to 18 (17.4% of the total papers published) (see Figure 8). It is apparent that by about 1909 the subject of mine safety and accident reduction had become an important topic of discussion. The reason these papers are seen to increase at this time is because of the growing safety movement in the steel and iron ore mining industries. Safety continued to be a topic of discussion at the LSMI and gained in importance. Interest in the promotion of safety resulted in the organization of the Lake Superior Mining Section of the National Safety Council in 1919.

Figure 8. Number of Articles Pertaining to Safety, Fatal Accidents, or Fatal Accident Reduction Found in the Proceedings of the Lake Superior Mining Institute (LSMI): 1893 - 1939.



In 1909, John T. Quine of Ishpeming, in his paper entitled "Mine Accidents" noted,

> The accident question in and about the mines is a very serious one and one that commands the attention of all employers of labor...It is a question that we have always had with us and will continue with us as long as we are engaged in the mining industry. The question at the present time is receiving more attention from the employer than at any time in the past and a good deal more is being done by the mining companies to prevent accidents and loss of life. In the mines of Marquette county there has been a constant improvement in methods tending to the prevention of accidents. I mean there have been more safeguards thrown around the men at all of our mines (p. 71).

It is apparent that Quine supported as causes of accidents both the lack of skilled labor and the high percentage of non-English speaking labor. He noted the movement of experienced miners to the new mining regions and the influx of immigrants to the area. He also felt that carelessness and disobeying orders on the part of the men were major contributors to fatalities. After making a comparison of death rates in coal mines among various countries (United Kingdom = 1.31, British Empire = 1.33, Austria = 1.27, Belgium = 1.04, France = 1.10, Germany = 2.55, United States= 4.66), Quine summarized the data as it affected the overall productivity of labor;

> Granting that the underlying conditions are often quite different and that many of our industrial accidents are the result of ignorance, recklessness, indifference, disobedience, or carelessness the fact remains that a vast amount of injury is done to health and strength...which has a very considerable economic value to the nation as a whole (p. 76).

It is also apparent that economic value to the mining companies was also an important consideration in the new movement toward accident reduction. Quine discussed a peculiar custom associated with fatal accidents in the mines of the iron country which had considerable economic impact.

> The custom at nearly all of our mines in case of fatal accident, is that the men quit work until after the funeral, thereby causing a considerable loss of money in wages to themselves, an average possibly of about $2.30 per day per man, and to the company operating the mine, an average of $500 for fixed charges for every fatal accident that occurs. This has become so deeply rooted that it is almost impossible to overcome it, so that it behooves the mining companies and the men in charge of the different properties to use every precaution in order to try to overcome the accident question (p. 73).

Prior to this time economic considerations had excluded any concern for the welfare of the miners. Now the industry recognized that the welfare of the employee had become an important economic factor also. Admitting the earlier philosophy of the mining industry with regard to accidents, W. H. Moulton of Ishpeming addressed the LSMI in 1909;

> The mining industry must be considered as having one paramount purpose, that of producing ore at the least possible cost and disposing of it at the highest price...In the early days of mining there was little thought given to anything but the physical aspects and to how the ores might be extracted and disposed of at the highest price...There was too little concern about the man or his family. He was a factor in production and the main question was a sufficient supply of him to produce the required output.

Moulton continued,

> These accidents should demand a most careful study not only for the reduction in economic loss and the added cost of production, but the effect upon the men employed (pp. 82, 83).

Many things done by the companies did actually help the employees but the gain for the company was always present. "The mining companies have always stood for good schools," Moulton told his audience in 1909, "and have been very generous in the question of taxation for school purposes, and the amount of money expended for buildings, equipment, and salaries." But he concluded, "We should see that...the

school teaching be so presented that our young men may consider it worth their while to look for their future work in our mines" (Moulton, 1909, p. 87).

The companies erected club houses for the men in some areas and CCI and the Lake Angeline Company helped the local people establish a YMCA at Ishpeming. CCI also erected a YMCA at Gwinn, the model town which they built on the Marquette Range. Although not bad for anyone involved the reason is again spelled out by Moulton;

> If the broad YMCA plan should be introduced in all of the various mining localities...much might be done in solving the problem of how to assimilate the large numbers of men coming to our communities not acquainted with our customs, habits of living and ideals of government (p. 92).

CCI also adopted a pension system in 1909 (Moulton, 1909, p. 95). As with other welfare programs many of the benefits derived accrued to the employer. A pension plan provided a way to attract and hold employees. One problem the mine operators had faced for a long time was a constant movement away from the Marquette Iron Range of skilled employees in search of better opportunities. The unskilled who replaced these men created a liability in terms of accidents, raised fixed costs through their inefficiency and were, because of their political beliefs, highly susceptible to the overtures of the unions. A pension plan would bind the employee more closely to the company and since unions were, in effect, competitors for the loyalty of workers the plans would serve to undermine them also.

As public distrust of large companies grew, mainly through the efforts of the "muckraker" journalists, pension plans also helped them create a favorable public image.

> Now what are we going to do with these men (the aged employee)? asked an employer in 1928. It is easy to say that we owe them nothing and that when we are through with them we will simply cast them adrift. But you know and I know that we don't do anything of the kind—not if we are running a large company or one that is much under public scrutiny... (Brandes, 1976, p. 103).

In 1911 Elbert Gary stressed that management had a duty not only to themselves but also to the public and to the company's workers. Safe and healthful working conditions were, he stressed, both "right" and "of advantage to employers" (Aldrich, 1997, p. 92). In 1912 U.S. Steel spent $750,000 per year in accident prevention and saved over $1.4 million in injury payments (Aldrich, 1997, p. 92). It is easy to see that management was transforming safety work from humanitarianism into a truly profitable activity.

From 1911 on, the influence of the "Safety First" movement in the iron ore mines is very markedly reflected in the LSMI proceedings. At the 1911 meeting, Alex M. Gow of Duluth, Minnesota, in his paper describing some safety devices of the Oliver Iron Mining Company made direct reference to the safety program of U.S. Steel:

> The Oliver Iron Mining company, which is the ore-producing subsidiary of the U.S. Steel Corporation has been diligently working along lines suggested by the general safety committee (of U.S. Steel)...to formulate plans for the safeguarding of employees (p. 159).

In the same year, in his paper entitled "Social Surrounding of the Mine Employee," Charles E. Lawrence of Iron Mountain made reference to the "Safety First" movement as he discussed how safety work could be carried out in the mines.

> The safety committee, composed of from 3 to 5 employees of average intelligence, at each mine, could easily criticise (sic) all dangerous places, and have them properly fixed to save injury. Their report of

> criticism could be gone over by a meeting of bosses and employees, say once a month, and in this way, spread the general information of "Safety First," which makes a vital, live subject in which each and all are interested (p. 123).

However, he left no doubt about the economic side of the issue. He, in fact, made it the primary concern. After he noted that the labor cost in mining was from two-thirds to three-fourths of the cost of production Lawrence concluded:

> The suggestions offered seem warranted and demanded, first, because of financial returns and second on civic humane grounds, also to change the small distorted ideas of the foreign laborer towards his employer to one of mutual respect and confidence, all of which will give a cheaper cost in the ore produced...(p. 125).

In 1912 William Conibear of Ishpeming began his paper detailing the system of safety inspection of the Cleveland-Cliffs Iron Company; "Conservation of human life is the slogan of the industrial world today. Recognizing that it is of prime importance to prevent injury, not alone from a humanitarian standpoint but also because it pays as a business proposition..." (p. 94).

The economic advantage to be gained from accident reduction remained a prime consideration of the Safety Movement on the Iron Range. At a meeting of the Lake Superior Mine Safety Conference in 1923 George Martinson, the Range Safety Inspector for Pickands-Mather Company, used an economic comparison to illustrate the advances in safety work that had been made;

> Arthur H. Young...states that the U.S. Steel Corporation, during the period from January 1, 1912 to September 30, 1922, spent in safety work $9,763,063. Using the cost of accidents to the International Harvester Company as a basis for figuring the total saving, (Young) found that $16,541,240 had been saved. This figure is based on the assumption that the frequency rate (of accidents) would have continued to be the same as in 1906, if no effort had been made to reduce

accidents. Thus it can be seen that an investment of $9,763,063 saved an expenditure of $16,542,240 or a net savings of $5,779,177 (p. 64).

Martinson concluded;

> In closing I wish to thank you for your past cooperation and ask you to continue to assist us in our efforts to eliminate in so far as possible the terrible economic waste resulting from industrial accidents (p. 67).

In 1912, William Conibear admitted that economic considerations had been more important than the accident problem and that the high fatality rate could have been prevented.

> The economic phase of mining, however, has been paramount and perhaps there has not been the amount of attention devoted to safety that it is justly entitled to. As a consequence the fatality rate has not shown a marked reduction nor does it compare favorably with the fatality rate in other mining districts of the country (p. 95).

Conibear went on to describe CCI's safety rules and regulations printed in English, Finnish, and Italian, which each workman received. Additionally, he discussed the system of safety inspection and safety committees, provision for first aid at the mine (started under the instruction of the U.S. Bureau of Mines), and the company's mine rescue stations.

In 1914 the first annual first-aid contest was held at Ishpeming, sponsored by the LSMI. The Institute had appointed a committee on the Practice for the Prevention of Accidents in 1912. This committee represented the first active interest of the Institute in safety work (Stevenson, 1914, pp. 269-270). The report of the contest, given at the 1914 meeting, credited the Safety Movement for stimulating the interest in first aid to the injured in the mines. After noting that the inception of first aid work in the Lake Superior mines had followed its development in other districts, but was

undergoing rapid development at the time, C. S. Stevenson, the contest announcer, made the following observation; "The development of the idea of safety in mining has perhaps resulted largely from the tremendous "Safety First" movement which had invaded all industries throughout America within the past 10 years" (p. 269).

That the mine itself represented a safety problem in the early days of mining is a fact. Nothing was lighted, protected, or even kept in an orderly fashion. The mine was often a trash heap of sorts that reflected the prevailing attitude of get the ore out quickly and cheaply. A mine is, by its nature, not a permanent feature and it was treated as such.

At the 1923 Lake Superior Safety Conference, J. H. Hearding, assistant general manager of the Oliver Iron Mining Company in Duluth, provided some reflections from the earlier days of mining that pointed out how much progress had been made in making mining a safer operation.

> You men will be surprised to know that at that time there was not a shaft or raise that had a rail around the collar and there were no regulations making it necessary (p. 119).

He related the case of a Cousin Jack mining captain who was standing at the bottom of a raise at the moment that a miner fell through and landed at his feet. The Captain said, "Ere, 'ere, my son, wot art a don' 'theer," and the miner replied, "Damme, captain, I was walkin' along and got to the raise and jus' as I was goan' across, I stepped on a plank, and the plank wasn't theer, and down I come plank and all" (p. 122).

And in his memoirs, Charles Stakel, CCI Mining Engineer recounted a 1928 trip to Iron Mountain to observe a mine which consistently went a whole year without a

lost time accident. The striking thing about the mine was the extreme cleanliness and orderliness. Everything was well lit and white washed. Steel gates protected all openings that a man could fall through and all of the miners wore goggles and hard-toed boots. Upon his return, Stakel and the mine captain in the Morris-Lloyd Mine at North Lake undertook an extensive house cleaning campaign. Stakel related that in addition to the house cleaning,

> We also adopted a set of rules and regulations to make sure that every miner was doing his work in an orderly fashion in the proper way, with the idea that if a miner and all other employees were performing their occupations in the proper manner they would not only be more efficient, but there would also be no accidents (Nelson, Nelson, and Williams, 1994, pp. 113-114).

And it worked recalled Stakel, "The Morris-Lloyd Mine ran 465 days or about a year and one-third without a lost time accident" (p. 114).

This occurrence precipitated the first CCI sponsored safety picnic, on Labor Day, September 2, 1929, for the employees of all CCI mines, as well as those of the Morris-Lloyd, and their families. The idea was to spread the news of this outstanding accomplishment and the method through which it was accomplished. William Conibear said of the company sponsored picnic,

> What I have in mind is that I want the other mines to know what the Morris-Lloyd mine has accomplished, and I think perhaps we can shame them into having a better safety record (Nelson, Nelson, and Williams, 1994, p. 114).

William Mather, then president of CCI, also wanted to be present.

> ...I want to congratulate the employees of the Morris-Lloyd Mine for having made this wonderful no lost time record for 465 days, something that has never happened before in the annals of the Cleveland Cliffs Iron Company (Nelson, Nelson, and Williams, 1994, p. 115).

This unique event occurred nearly 30 years after CCI was formed, 46 years after the main groups of non-English speaking immigrants had arrived to work in the mines, 42 years after the office of Mine Inspector was instituted, and after nearly 50 years of technological development and improvement. The reduction in accidents that resulted in the first safety picnic was possible only after it had become apparent that the accident problem did have a solution. Previously, no solution had been sought simply because there was no need to find one. But to lower the accident rate, both fatal and non-fatal, had become economically, legally, and politically advantageous for the mining and steel corporations. In order to protect their pocketbook, the managers and owners of the large companies had to take an interest in accident reduction and safety, and the sincerity of that interest had to be communicated to the men by visible improvements and, above all, enforcement of rules and regulations. Accident reduction had to become everybody's business.

Necessity of Management Involvement in Fatal Accident Reduction

There are plentiful examples from the analysis of LSMI proceedings that point to the fact that the fatal accident rate could not be reduced until it became a management priority. The cooperation of the men was certainly necessary but that could only be gained through enforcement of safety rules that originated at management level. Safety did not begin in the mine, it began in the office.

In 1913 Edwin Higgins, District engineer of the U.S. Bureau of Mines, had noted, "The seed of 'Safety First' sowed some years ago on the iron ranges has become firmly rooted"(p. 63). After enumerating the types and successes of various safety devices and measures, Higgins discussed the accident problem and its solution; "The

average miner resents suggestions for his safety," Higgins noted. "He will take care of his dinner pail and he will be careful to get all that is coming to him from his contract, but he will not take the necessary precautions to safeguard his life" (p. 81). Higgins then arrived at the root of the problem as he saw it;

> Safety devices are good and they are absolutely essential for protecting the miner; if they could be coupled with a mine full of men whose thoughts were for their safety, then conditions would begin to approach the ideal. The method of securing this cooperation is the problem of management...(pp. 81-82).

In other words, management had to have an interest in safety and could make it effective through enforcement of rules from the top down.

> Unless the mine official is of the firm belief that safety pays, little may be expected from the men under him. The best results seem to be forthcoming from the mines where the slogan 'safety first' is strong with the officials, and by them is made to permeate every department until it finally reaches...the men behind the drill, the pick and the shovel (p. 81).

Realizing the necessity of securing the interest of top management in order to make the safety idea effective, Higgins closed his paper with an allusion to the economic side of the issue: "The protection of our fellowman is a duty that we owe to ourselves and to mankind. If there is no appeal in the humane side of the question, study it from a standpoint of dollars and cents, for safety in mines pays, first, last and all the time" (p. 84).

At the LSMI meeting in 1929, it is apparent that the idea of accident prevention as a management function was well established. First stating that 95% of all accidents were preventable, D. R. Henderson, Chief of the Accident Prevention Division of the Industrial Commission of Labor of Minnesota, went on to explain that;

> The cause of these accidents was the carelessness of somebody. There is where accident prevention science has its greatest battle to fight—eliminating carelessness and destroying the false sense of security in the minds of employers, foremen and workers of the rank and file of industry (p. 139).

He continued,

> Only continuous pounding and repetition by safety engineers on the value and means of avoiding accidents can permanently establish the habit of safety and self-preservation in the imperfect human brain (p. 140). Safety work must be organized. This can only be accomplished through safety organizations. The efficient safety organization starts at the top—the owner, a manager of the plant must be sold to the idea of safety...A safety organization without an enthusiastic management back of it is a failure (p. 141).

Henderson also acknowledged that many efforts were not sincere,

> Too many organizations are started with the sole purpose of securing a reduction in insurance rates...or that the employer feels he has to or is required by law to provide safeguards to protect his employees (p. 141).

An interesting statement made by William Conibear, safety inspector for CCI, to the LSMI in 1925, illustrates the role of operators in reducing fatalities:

> In 1911 a number of Lake Superior mine operators decided that in order to reduce accidents it was essential to provide safer working conditions and that employees should be shown that their safety was a prime and fundamental consideration. With this object in view, safety departments were organized and campaigns for the reduction of accidents were inaugurated. Interest in this phase of mining has increased since 1911, and today practically all operators, recognizing their responsibility for the prevention of injuries and accidental deaths, are concentrating their best effort on plans for the elimination of the hazards of the industry. No longer is the economic phase of mining regarded as paramount. Equal in importance has become the slogan 'Safety First' (p. 314).

D. Harrington, Chief of the Safety Division, U.S. Bureau of Mines, reinforced the idea of the necessity of management involvement in safety in his address to the LSMI in 1930. He stated:

> The exact form of the safety organization is not nearly as essential as is the necessity to have a definite organization looking toward forwarding mine safety and with the correct spirit behind the organization. One of the essentials without which it is nearly impossible to get real results in mine accident prevention work is that the mine officials, not only the lower operating ones but, fully as important, those in higher positions, should be in full accord with the vital importance of mine safety...It is significant that where in a few isolated cases, the 'higher ups' are really interested in safety, their mines almost invariably have good safety conditions and good safety records (pp. 300-301).

According to Harrington, although important, interest by the "higher ups' was rare. This was in metal mines in general in the United States, not specifically the Marquette Range Iron mines, where management interest in safety was generally high.

The idea that safety was something that must be backed by rules and regulations was also brought out in Harrington's paper, "...by far the most important factor is education and by far the best method to provide widespread education among employees in and around the mine...is the very effective combination of intensive intelligent supervision and careful, rigid discipline" (p. 303). Also, it appears that the idea of working safely was difficult to ingrain, "It has been said that safety can be secured and maintained only by everlastingly keeping at it, and this is most certainly true; any relaxation in 'keeping at it' is practically sure to result in at least a relative increase in accidents" (pp. 302-303).

But it wasn't just the idea of working safely or just "safety" that finally made the greatest inroads into reducing the number of fatal accidents and all accidents in general in the mines. It was the recognition by the owners and operators that there had to be a fixed and uniform set of rules or standards to follow in every phase of the mining operation, and it was the responsibility of the employer to see that these

standards were enforced. The standards, as defined by William Meyers, Superintendent of Holmes and Tilden mines, were basically safe work practices which he defined as simply the best methods to carry out the mining operation that could be devised at the time they were adopted. Meyers told the LSMI in 1930: "The significance of the safety movement will not be understood or appreciated where doubts exist or opinions differ as to what really constitutes safe practices" (p. 149). These work standards would be designed by the mine officials and enforced by the foremen. The information for setting the standards by which men work would be gleaned from those who carry out the work or whose duty it was to see that the work is done. Management must use this information to force men to observe safe practices. What it boiled down to, according to Meyers, was discipline; "Formulating or prescribing a code of safety standards for the various operation...will not of itself stop accidents" (p. 152). What must be had was the cooperation of all employees, infraction of rules or regulations could not be condoned. "Disciplinary leniency will not direct the serious attention of men to the object and purpose to be derived from the observance of standards" (p. 152).

Supervision, discipline, and management involvement were the important factors in accident prevention according to Meyers. "Safety in industry is now acknowledged as an executive matter. Present day advanced safety practices in industry places the responsibility for accidents and their prevention directly upon the employer" (p. 148).

In 1930 William Conibear gave a talk to the LSMI outlining the success of CCI's safety program. He noted that failure to conform to well defined safety standards

on the part of both supervisory force and the men in the mines was the direct cause of 75% of all non-fatal injuries that had occurred in the past 40 years.

> As experience showed that the causes of many accidents were traceable to unsafe ways of doing work, negligence, and indifference, standardization of mine equipment and mine operations became imperative...and it has resulted in the desired effect of reducing accidents (p. 182).

Necessity of Worker Involvement in Fatal Accident Reduction

As management became involved in reducing workplace fatalities, a myriad of warnings, printed rules and regulations, and accounts of mine accidents with illustrations showing how men were injured came into existence as methods of securing the cooperation of the miner to take precautions for his safety. Inspection committees and personal contact of employees with officials, captains, and shift bosses were also thought to be effective. But according to Higgins in 1913; "These methods are more or less productive of results, but there still exists a woeful lack of willing cooperation among the miners. Just how this condition may be improved is a problem, the solution of which will do much for the cause of safety in the mines" (p. 83).

Higgins suggested that all of a company's safety devices, rules, and regulations were essential for protecting the miner but, "Far more good may be accomplished by securing the cooperation of the man underground than by the use of safety devices or measures of any other kind" (p. 81).

In a message directed to the Lake Superior Mine Operators at the Lake Superior Safety Conference of 1923, J. H. Hearding, Assistant General Manager of the Oliver Mining Company, noted that education was the best policy for reducing accidents.

> Mechanical contrivances can be used to limit the dangers and great work has been accomplished in making devices which will produce safer conditions for the man working in and about the mines. But the better method is...the education of the men in regard to their own safety, and the safety of their fellow men. That education has done, and will do, more than anything else to conserve life, limb, and property (p. 121).

Hearding pointed out that safety work had reduced the accidents to approximately one-half and in closing remarked; "That record is a very remarkable one and is due, as I said in the first part of this address, to the education of the men to perform their work in a safe manner" (p. 123).

In the same year, B. D. Shove, Safety Engineer for the Oliver Mining Company, stressed an ingredient necessary to the success of any safety program—cooperation;

> In order that we may get the best results out of our campaign to prevent accidents it is absolutely necessary that all concerned worked with greater unity and closer cooperation (1923, p. 123).

He continued,

> The workman enters into this cooperation plan to a very large degree. The greatest part of his personal safety is up to the man himself. When our men are educated to the extent of feeling ashamed of themselves when injured because it reflects on their workmanship and efficiency, then we will get far better results (1923, p. 125).

Also, at the 1925 meeting Frank O. Botsford, District Manager of Pickands-Mather Company of Hibbing, Minnesota, looked back to the earlier days of mining and the creation of various safety departments by the iron ore mining companies. He recalled the following:

> As I look back to those days I can see that our first efforts to further the promotion of safety were very crude. We had never given the question much thought; we believed that our mines were as safe as anyone could reasonably expect them to be; we felt that we were taking every

> precaution to insure the safety of all employees. We see today, after years of thinking and analyzing from a safety standpoint, that many conditions that we believed to be safe then were actually hazardous to a high degree. This clearer vision was not developed by any change in our ideas as to the value of human life, but was brought about by the thinking along safety lines by safety engineers, mine operators, and by the men themselves. The power of thought is unlimited and when a large number of men are thinking on one subject the dark corners become bright. They see more, they see more accurately. Where before we saw the obvious now we see all sides and even beyond the object or condition viewed, and discover the hidden danger which would not have been visible to us if we had depended on our eyesight alone. It is the thinking of many men that is responsible for the great progress in safety work, and our future advancement will depend entirely on how clearly we think (pp. 290-291).

The major decrease in fatality rate seen in 1920 resulted from a combination of the events that occurred in the decade before 1920, the pressure of national events, public pressure, and most importantly the effects of the Safety First Movement.

CHAPTER 11

ANALYSIS OF FATALITY DATA

Introduction

Analysis of the fatality data generated by the present research indicates that the period of underground mining for which fatality rates can be calculated (1889-1979) can be divided into three distinct segments on the basis of a major change in the average fatality rate:[8]

(1) 1889 to 1919, a 31-year period in which, with only one exception, the annual fatality rate was greater than 4/1,000 underground workers. The average fatality rate for the period was 4.87/1,000.

(2) 1920 to 1960, a 40-year period in which the annual fatality rate dropped to substantially less than 3.0 fatalities per 1,000 underground employees. In this 40-year period, there were only four years in which the underground fatality rate rose above 3.0/1,000. The average fatality rate for the period was 1.48/1,000.

(3) A period beginning in 1960 in which there were several consecutive years where no fatalities among the underground employees were reported. In this 20-year period there were only four years in which fatalities occurred. The average fatality rate for the period was 0.56/1,000.

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[8]The first decade of underground mining on the Marquette Range has been omitted from the final analysis because no fatality rates can be calculated and therefore the basis for comparison is lost. The likelihood that this decade was one with a very high number of fatalities has already been discussed. It is also very likely that the fatality rate was high because at that time in the evolution of the iron ore mining industry production was highly dependent on manpower.

1889 to 1919 Inclusive: The Era of High Fatality Rates

It is not difficult to explain the high fatality rates in the period before 1919. They resulted from the mix of social, technological, political, legal, and economic factors discussed in the previous chapters. The list of eight factors believed to have been responsible for the high fatality rate compiled by others and presented in Chapter 2 covers the causes well. There are no solid data that point to one factor as a greater contributor to the high fatality rate than any of the others. They all combined to make the fatality rates in the iron ore mines of the Marquette Range some of the highest in the world in mining at that time.

The conditions that existed on the Marquette Range during the 1889 to 1919 period were conducive to both the occurrence and acceptance of a high number of fatalities in the mines. The mines were being rapidly developed because of increasing demand for their product in an isolated region in which a largely non-English speaking, immigrant workforce, consisting of relatively young, inexperienced laborers toiled in the absence of supervisory control and protective laws.

The contract mining system which treated miners as private contractors, prohibited any effective managerial control of the miners underground, and dulled supervisory interest in safety. This was legally reinforced by employer liability laws which made accidents cheap, or even free, for the mine operators.

"Carelessness," generally considered the main contributor to fatal accidents, was diminished as a cause by Crystal Eastman's study. Widely publicized as the cause of fatalities, it was also one of the primary defenses that employers had to protect themselves from liability for accidents. Coupling the known hazards of the industry,

also widely publicized, with the fact that the fatalities were considered to be non-preventable ensured the employer of winning any lawsuits that might arise. Undoubtedly some men were simply careless when they should have known better but, as Eastman found, most "careless" acts could be attributed to concrete causes. It was easy to attribute accidents to the carelessness of the man who died, the result, of course, was that the real causes remained undefined. To reduce or prevent fatalities, however, the real causes needed to be identified. In 1989, U.S. Bureau of Mines research showed that more than 80 percent of all coal mining accidents, in some way, involved human error. A Bureau researcher stated, "Inadequate or inappropriate performance is often dismissed as the individual's human error, but when individuals commit errors, there are causes for these mistakes. We must seek to discover these causes" (Ary, 1989, p. 10).

Lack of mining skill was also a contributor to the high number of fatalities during the first four decades of mining. Between 1880 and 1896 a large number of skilled miners left the Marquette Range for better opportunities elsewhere. Unsettled conditions and numerous strikes, especially the Strike of 1895, also contributed to the loss of skilled labor. The skilled miners were replaced by men who had little prior mining experience, mainly the Finnish beginning in 1883 and the Italians beginning in 1887. As the unskilled replaced the skilled the fatality rate went up (see Figure 5).

During this period, the greatest number of deaths occurred among men in their 20s (see Table 12). There are no data from which the age of the entire mining workforce at a given time can be determined but it is logical to assume that, as a whole, the mine workers were relatively young. The high number of men in their 20s

killed is an indication of this as a fact. Additional factors related to age that could contribute to the likelihood of a fatal accident are inexperience and the fact that men in this age group are more daring and possibly not as responsible as their older counterparts. An account of the death of Frank Hooper supports this suggestion; "Frank Cooper met death in the Republic Mine when in disregard of orders he tried to jump on a moving skip, slipped and fell 120 feet. He was 18 (Mine Inspector's Report, *Daily Mining Journal*, October 17, 1896).

The lack of enforceable rules and supervision was also an important contributor to these fatalities.

The data also shows that the largest number of men killed were Finnish (see Table 12). The Finnish came to represent the largest proportion of the underground workforce on the Marquette Range (see Table 7). It is logical that they would have the highest exposure to the hazards that existed. Additionally, as already noted, they were not skilled miners, and many did not speak English.

It would be expected that men who could not understand the language of their boss or supervisor, which was English, or could not understand each others language while on the job, would be more apt to encounter accidents. Their inability to understand specific directions or to heed warnings from fellow workers would leave them extremely vulnerable. By 1909 the U.S. Immigration Report shows that only 57.3% of the mine workers spoke English (see Table 9). Up to 1910, of the deaths reported in the *Ishpeming Iron Agitator/Ore* and the Mine Inspector Reports where it was possible to determine nationality, it was found that 257 men died whose native tongue was not English and 99 died whose native tongue was English. These numbers

Table 12. Fatalities by Age and Nationality in the Underground Mines on the Marquette Iron Range, By Decade; 1880-1979.

Time	Teens	20s	30s	40s	50s	60s	70s	English	Finnish	Swede	Irish	American	Italian	0
1880s*	6	21	6	6	1	—	—	5	6	15	1	1	1	12
1890s	4	19	23	15	3	—	—	48	48	19	10	2	4	6
1900s	15	72	40	30	12	2	—	41	78	20	2	2	22	13
1910s	9	70	37	36	10	1	1	28	78	7	2	9	23	15
1920s	—	9	15	9	4	2	—	4	13	1	2	5	6	3
1930s	—	5	6	8	4	2	—	1	8	—	—	5	5	2
1940s	—	6	8	5	5	1	—							
1950s	—	8	—	7	3	—	—							
1960s	—	—	1	4	3	1	—							
1970s	—	—	—	—	—	1	—							
Total	34	210	136	120	45	10	1	127	231	62	17	24	61	51

* Very limited data.

could reflect a higher propensity for those who did not speak English to be involved in fatal accidents or simply the higher number of foreign workers employed.

The effects of technology on the high fatality rate before 1912 have also already been discussed. There is not a lot of data from which to draw that pertain to the exact timing of the introduction of new technology on the Marquette Range. However, it is known that both new technology and mining methods were introduced relatively early in the history of the underground mining (beginning in the early 1880s). It is also known that all mines did not employ the same technology and that some were not far removed from being scrap heaps. There is also an indication that in order to control fixed costs, which was a major problem on the Marquette Range due to intense competition, especially in times of recession or depression, equipment may have been run to its limit before it was replaced.

In 1900, President of the LSMI William Kelly recounted the many ways in which individual mine operators cut costs after the Panic of 1893:

> When the Panic came and the mines curtailed operations there was a surplus of mining material of different kinds which was drawn on until exhausted...this 'skinning' process could only be for a time and when expansion came again, replacements were all the greater (p. 22).

Kelly also noted:

> Under the necessity for retrenchment, the duties of every position were carefully scrutinized and readjusted. Thus, a skip tender was dispensed with at one level by putting in a speaking tube to the next, or a skip tender was intrusted with the care of the pump, or a dry-house man required to look after the oils or an oil man to make wedges. Those who had held the abolished places were not necessarily dismissed, but when possible, were added to the forces more actively engaged in increasing production (p. 20).

Men, put into a job for which they lacked experience or knowledge and using worn equipment and supplies, could easily be involved in fatal accidents. This is particularly true during the 1890 decade after 1893.

The Bureau of Labor report of 1898 suggested that accidents were not necessarily due to the use of old or new technology, but instead were related to the lack of inspection of existing equipment and the lack of installation, on equipment, of safety devices that existed and were required by the State Factory Inspection Laws with which the mines did not have to comply. The lack of compliance with even those safety features required by the Mine Inspector Law was also noted by the Bureau of Labor.

Examination of the data in Table 10 shows that before 1912 the leading cause of death in the mines was falls of rock from the back or hanging. This was an accident factor that was very difficult to control. It diminished significantly after 1920 but remained the leading killer throughout the underground history of the Range. This factor was the least controllable by technology. It was a random occurrence that had to be guarded against by taking extreme care and observing the best mining practices and mine safety procedures. Education and skill of the miners was the best protection against this type of accident because, basically, the men had to protect themselves from this hazard. Until they were induced to become extremely careful, this cause of death remained high. There were 317 deaths due to falling rock and 137 deaths that could be attributed to technology (new or old machinery and electricity) from 1880 to 1920. After 1920 falling rock caused 75 fatalities and technology caused 22.

The suggestion that a change in mining method may have saved many lives was also found in the LSMI Proceedings. Stating that a considerable decrease in the loss of

life due to falling rock occurred when the principal method of ore extraction was changed from open stoping to top-slicing and sub-level caving, J. H. Hearding recounted these improvements at the 1923 Lake Superior Safety Conference;

> At that time we were using what was called an open stope...the open stope disappeared long ago with the improvement of mining and the adaptation of new methods. The open stope was a large room as big as this room, and the miners had to continually trim the back, and occasionally it would break loose and come down, severely injuring and sometimes killing the miners. The open stopes were replaced with a practice coming from Nevada where there were large ore bodies. This new method was called the square set. The square sets were discarded and the top slicing method adopted...then we went from the square set to the present "sub" system (sub-level caving)...All of those conditions have been continually changing for the better, producing greater safety for all employees, and particularly for the man who is doing the work in the mine (p. 120).

Whether or not sub-level caving was eventually used in all mines on the Marquette Range is not known, nor is the exact date of introduction. The method was, however, introduced into the Lake Angeline Mine in 1891. It can be seen in Table 10 that the number of fatalities caused by rock falls from the back decreased from 109 in the 1880s to 63 in the 1890s but then slowly increased until 1920 when it showed a substantial decrease. If the decrease in fatalities in the 1890s was related to the change in mining method then it was responsible for saving a large number of lives.

1920 to 1959 Inclusive: Accounting for the Substantial Decrease in Fatality Rate

Examination of the data in Table 4 and Figure 2 shows a sharp, substantial decline in the fatality rate in 1920. From that time on the fatality rate rose about 3.0/1,000 in only four years. Answering the question of why, for example, from 1910 to 1919 did approximately four out of every 1,000 underground mine employees die

whereas from 1920 to 1929 only 1.7 out of every 1,000 died is a major objective of the research.

It can be seen from Table 4 and Figure 2 that the raw number of fatal accidents also declined sharply in 1920. For example, the total number of deaths from 1910 to 1919 was 159 and the total number from 1920 to 1929 was 39. This decrease in the raw number of fatalities is partially related to a decrease in employment which also occurred beginning about 1920 (see Table 4 and Figure 4). This trend would be expected. It must be remembered that it is the exposure of men to the hazards (risks) of the job that determines the likelihood of fatal accidents occurring. The more men employed the higher the exposure and the higher the number of fatalities and vice versa.

In an attempt to obtain some information on the precision and linearity of the relationship between the number employed and the number of fatalities that occurred, a scatterplot was constructed (see Figure 10). It is obvious from the scatterplot that the relationship between the two sets of data is approximately linear. A regression line (a = -6.47, b = 0.006+) was determined using the least squares criterion and drawn on the scatterplot. Again, the approximate linearity of the relationship is obvious.

The fact that all of the points do not lie along one line indicates that, in addition to employment, other factors were involved in the determination of the number of deaths that occurred. The correlation coefficient (r = 0.91) suggests a strong but, again, not perfect relationship between employment numbers and the number of deaths. At least a portion of the variability in the actual versus the predicted numbers of deaths

Figure 9. Average Employment by Decade and Total Number of Deaths in the Underground Mines on the Marquette Iron Range: 1890 - 1979.

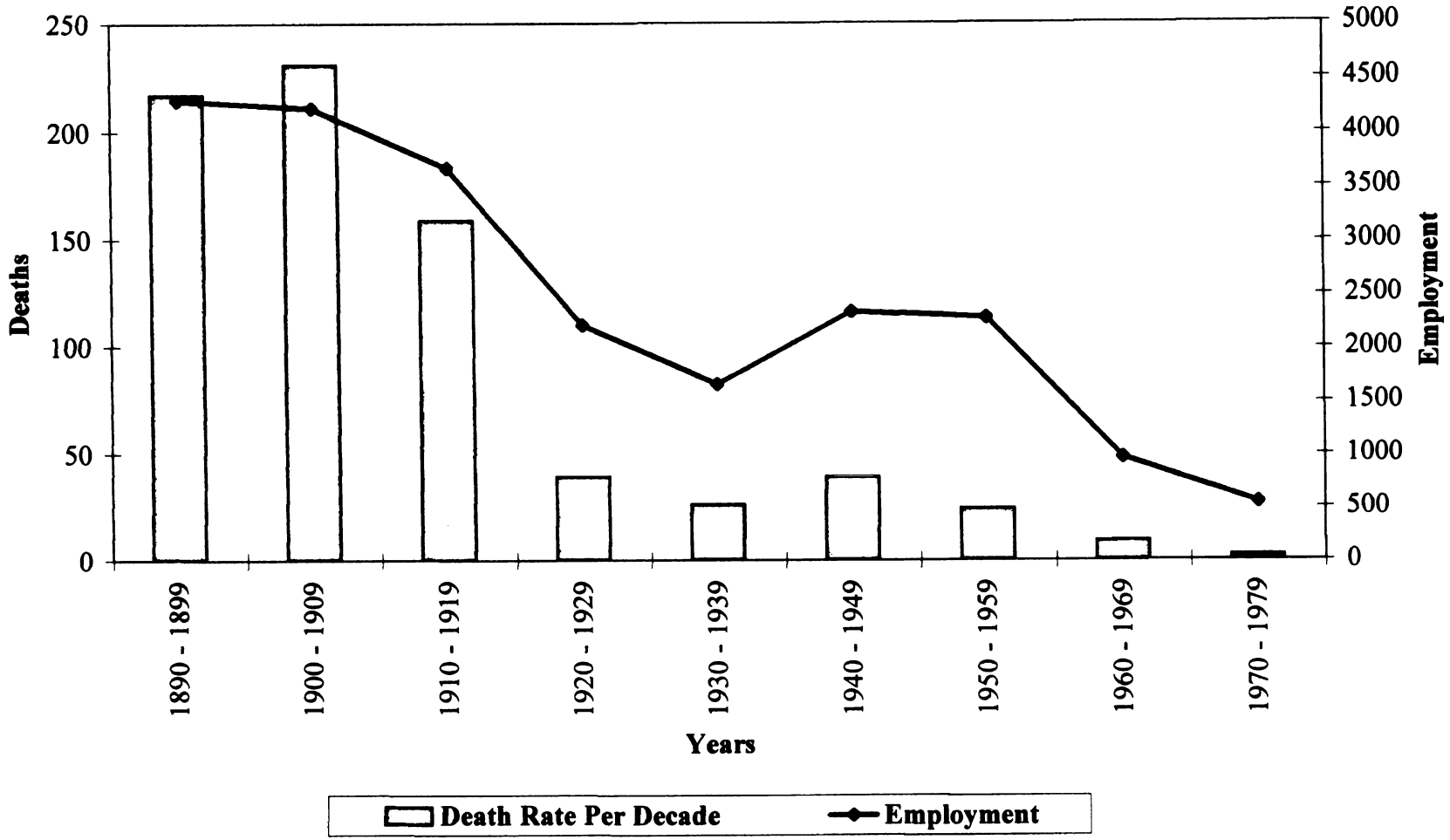
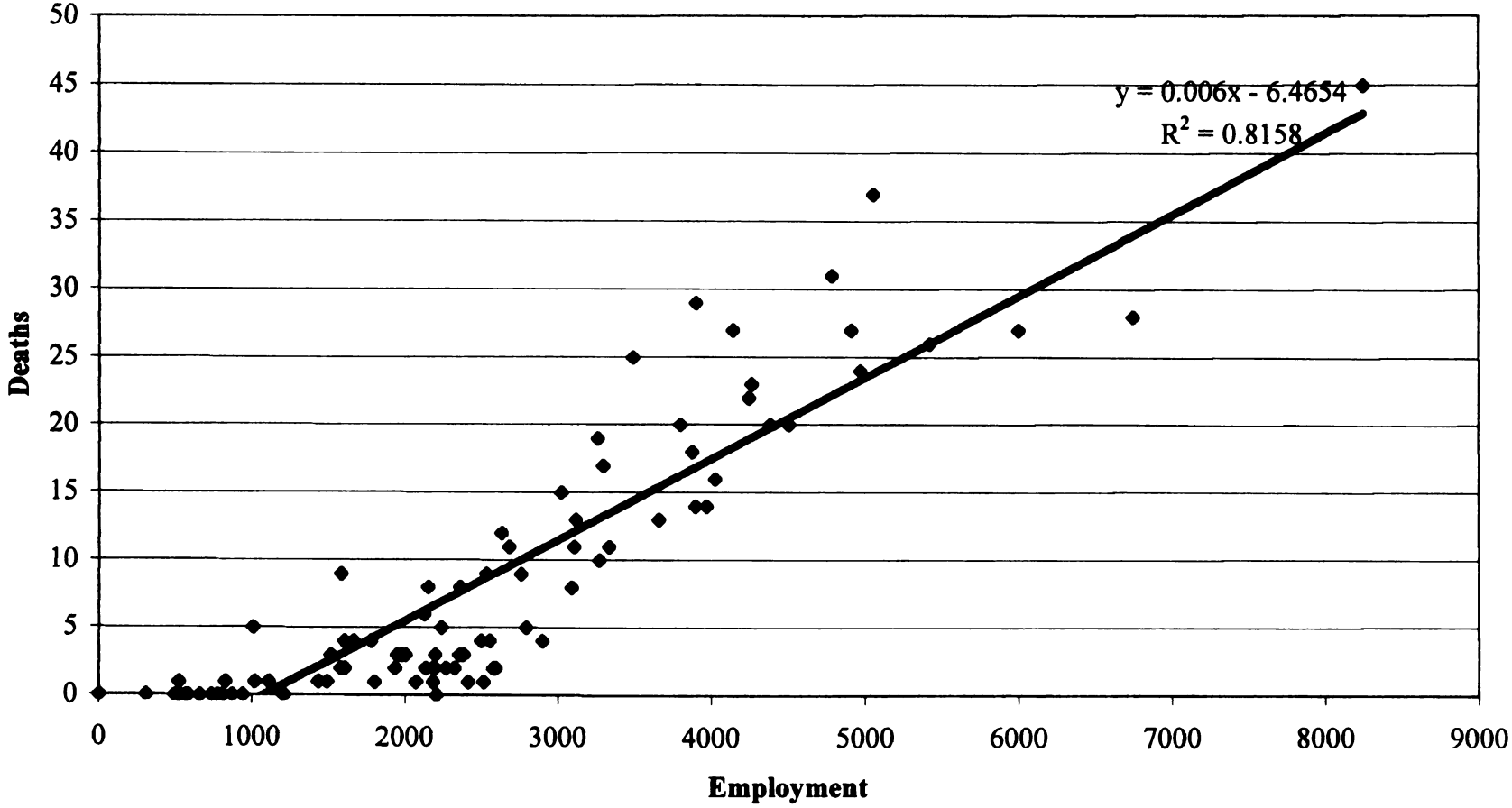


Figure 10. Approximate Linear Relationship Between Employment and the Number of Deaths in the Underground Mines on the Marquette Iron Range: 1890 - 1979.



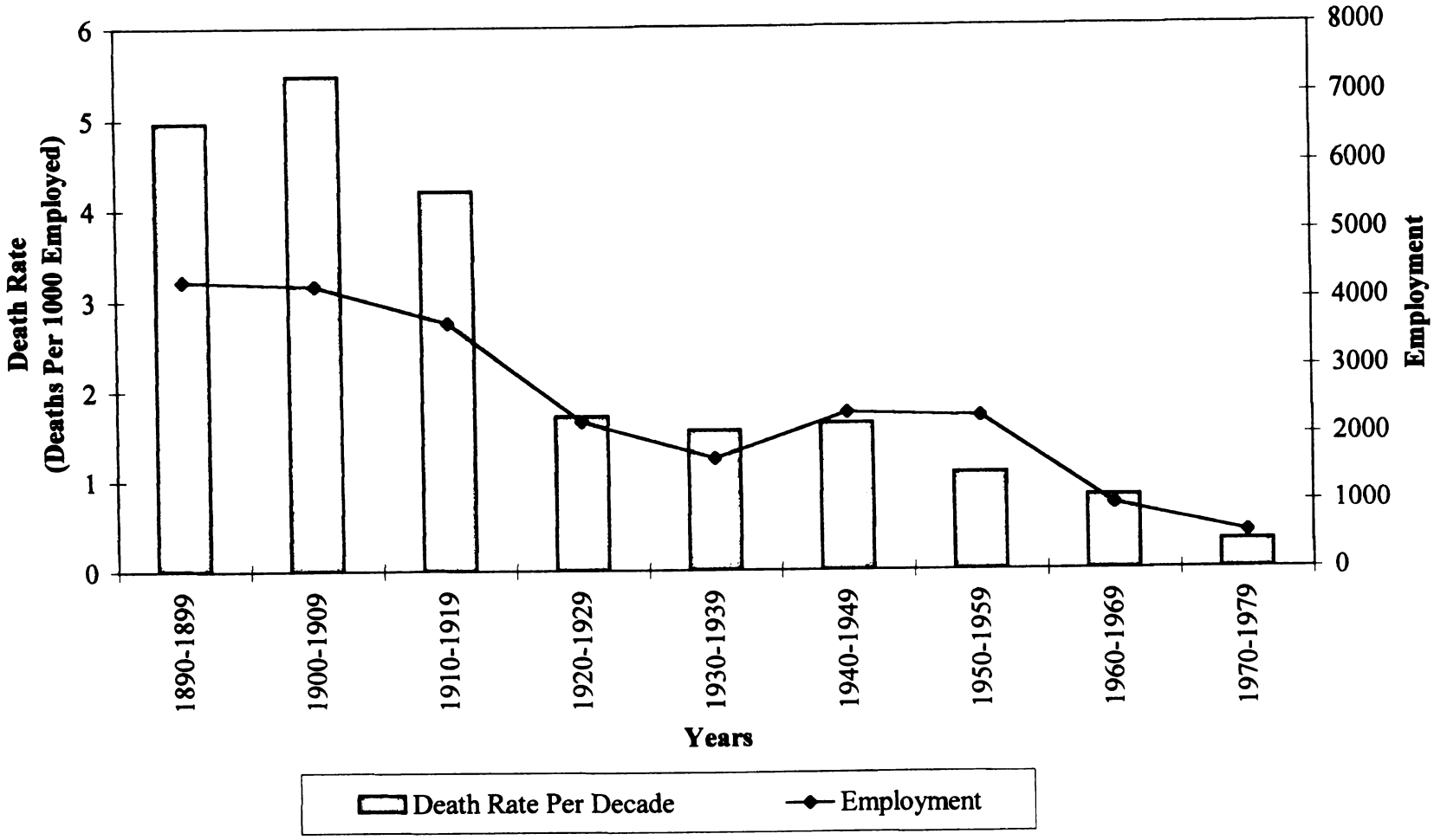
is not related to employment. Generally, after 1920, the regression overestimates the number of deaths.

Obviously, the substantial drop in fatality rate seen in 1920 is not related to employment numbers (see Figure 3 and Figure 11). Explanation of this observed decline and of the approximate rather than perfect linearity of the relationship between the number of fatalities and employment is a major objective of this research.

It is difficult to correlate the 1920 decrease in fatalities and fatality rate with new innovations in mining technology (machinery) or methods. The use of the safer, sub-level caving method of mining was well established by this time and apparently widely used by 1920 (Hearding, 1923, p. 120).

Around 1912 ventilation by mechanical control was started and used in all deep mines (Conibear, 1936, p. 183). The need to supply fresh air in underground working places was pointed out by the U.S. Bureau of Mines as necessary to preserving health and increasing labor efficiency but not as a method of reducing the fatality rate. Although certainly contributing to a better (and therefore perhaps safer) working environment, this innovation would hardly be expected to produce such a quick and marked decrease in the fatality rate. It is not known how many mines used this new technique of ventilation. Additionally, ventilation, using compressed air, had been used in the mines for many years previously.

Figure 11. Average Employment and Average Death Rate per Decade in the Underground Mines on the Marquette Iron Range: 1890 - 1979.



Undoubtedly, up to 1920 there had been a continual improvement in the capability and efficiency of mining machinery of all types which contributed to a safer work environment. However, no mention was found of an innovation around 1920 that would have contributed to the large decrease in fatality rate seen then. The most likely scenario, suggested by the limited past history of the introduction of technology on the Marquette Range, is that new technologies and methods were gradually introduced with some mines changing and some holding on to the old ways. This would produce a steady decline in fatality rate but not the sudden one observed.

The mining workforce was aging which may have made them more cautious. Also the unskilled workers who replaced the skilled workers who left the Marquette Range in the late 1800s were, by this time, more familiar with their jobs. The same is also true for the status of immigrants and their ability to speak and understand English. The percent of immigrants who spoke English increased markedly with their years in the United States. 95.3% of all races who had been in the U.S. ten years or more could speak English according to the U.S. Immigration Report of 1911 (see Table 13). Additionally, by 1911 many of the miners must have been second generation. The effects of age, skill, and proficiency in English would have produced a gradual decline in the fatality rate. At this point in time, these changes would not have been of sufficient impact to lower the fatality rate so quickly and as much as is observed. They would contribute to a steady, gradual decrease.

Table 13. Percent of Foreign-Born Male Employees Who Speak English, By Years in the U.S. and Nationality.

Nationality	Percent Who Speak English, by Years in United States				Number Reporting
	Under 5	5 to 9	10 or More	Total	
Croatian	16.5	65.2	85.0	32.3	158
Finnish	30.9	76.1	93.3	60.5	661
Italian, N.	32.6	80.0	94.0	45.3	541
Polish	30.5	77.1	90.2	51.1	393
Slovak	62.1	97.9	100.0	81.9	127
Swedish	63.6	96.3	100.0	89.4	160
Total	33.3	80.4	95.3	57.3	2,408

Note: From *Immigrants in Industries*, 1911, p. 428.

There were three occurrences before 1920 which could help explain at least a portion of the decrease in fatality rate and the number of fatalities seen then;

(1) In 1911 the Michigan Legislature passed a bill whereby the County Mine Inspector would be elected by popular vote rather than appointed by the appropriate county board of supervisors as he had been since 1887 (Michigan Public Acts, 1911, pp. 263-267). A previous bill also required the inspector to visit each mine in his district every 60 days rather than once a year (Michigan Public Acts, 1897, pp. 140-141). This changed the role of the Mine Inspector in the eyes of the mining companies. The inspector still had no enforcement powers but his selection by popular vote could not guarantee to the companies that the man in the job would be sympathetic to their views. Previous statements in annual Mine Inspector Reports indicate that at least some companies (or mine managers) played to the Mine Inspector's self-importance, "extending him every courtesy" and he, in turn, assured that the companies were

"doing everything in their power to make their mines safe and reduce the number of accidents." But with a person of unknown sympathy around every 60 days and the specter of the published annual report, it became advantageous for the companies to actually improve working conditions and therefore safety in their mines.

(2) In 1912, Michigan adopted a system of Workmen's Compensation. Workmen's Compensation made companies give specified monetary awards to injured employees who were out of work for a certain length of time and to dependents of fatal accident victims. The mining companies desired to participate in Workmen's Compensation because they gained a cap on the amount an employee or his dependents could receive. It ended the uncertainty about large jury settlements and the companies could budget the amount needed to cover accident expenses per year. However, to keep their rating good and their insurance expenses low, it was necessary to actually reduce the number of fatal and lost-time injury accidents. Safe working conditions in the mines became of prime importance.

(3) In March of 1911, CCI founded a safety department and appointed the company's first safety inspector, William Conibear. The safety department published a booklet of rules and regulations in English, Finnish, and Italian for all of their mines and established penalties for disobedience, set up local mine safety committees which reported to a central committee, instituted first-aid training and established five mine rescue stations. They also started a safety bonus for mine foremen to encourage them to place safety on the same level of importance with production (Conibear, 1912, pp. 96-102). Later data indicated that in CCI-owned mines the fatality rate per 1,000 men was 4.9 from 1906 to 1910 and in the five years following the founding of the safety

department in 1911, the rate dropped to 2.8/1,000. In fact, in only 18 months a decrease of 16% to 20% in minor accidents was noticed (Conibear, 1912, p. 110). Although this data covers only CCI-owned mines, CCI was the largest producer and employer on the Range and therefore their decrease in fatalities could easily affect the overall average.

The impending Workmen's Compensation Law and the new amendments to the Mine Inspector Law induced CCI to attempt to make their mines safer places to work. It was becoming economically important for them to do so.

Also, already discussed in detail were several factors that, even though they were outside of the mines and the Marquette Range, had a marked effect upon the ways in which the mining companies viewed their employees and the conditions in the mines. In the late 18th and early 19th centuries employers, not only in the Marquette Range mines, but all over the country moved to combat strikes and unionism, the threat of Populism and Socialism, anti-trust legislation and changes in the employer's liability system. The companies also needed to "look good" because they had become under intense public scrutiny as the result of articles about the horrid working conditions endured by laborers which were published in popular magazines by the "muckraker" journalists. The growing distrust of the large corporations and disgust over the treatment of labor was reflected to them through jury decisions. They suddenly found themselves paying large settlements for workplace accidents and deaths. The companies needed to move in such a way that they could continue to make large profits but also appear interested in the welfare of their employees and their employees' families. The stimuli and resultant necessity for change culminated in methods of improving working

conditions to promote safety and decrease the number of accidents. These proved to be cost effective techniques and were the essence of the Safety First Movement. It was this Safety Movement that was ultimately responsible for the decrease in the fatality rate initially seen in 1920. The frequent references to the Safety Movement and its success in reducing fatalities found in the LSMI Proceedings are also supporting evidence of its introduction and effectiveness.

1961 to 1979; Significance of Five Final Fatalities on the Marquette Iron Range

The last period chosen again shows a remarkable decease in fatality rate. After 1961 there were several consecutive years in which the fatality rate was zero. Between 1961 and 1979 there were only five years in which fatal accidents occurred. The only year with more than one fatal accident was 1967 in which five fatalities occurred. The fatalities that occurred in this year are very instructive in terms of the hypothesis that it was the Safety Movement, the rules and regulations set forth by management, that resulted in the major decrease in fatality rate seen in 1920.

The probability that five fatal accidents would occur in 1967 is less than 0.001. Analysis of the causes of these very low probability fatalities indicates that they follow the exact pattern of those that occurred in the earlier years. Two were attributable to machinery, two were the result of a blasting accident, and one involved a man who was knocked down a raise by a large timber that was being lowered.

One of the machinery accidents involved the failure of a bolt. A diagram and the circumstances of the accident were submitted to the U.S. Bureau of Mines for further study in hopes that in the future accidents of this type could be prevented. The other machinery accident occurred when a motorman failed to activate the warning

signals as required. The explosive accident occurred as two men set off a blast which detonated a cache of ammonium nitrate, dynamite, and electric blasting caps that was improperly stored and they did not know was there. The timberman was knocked down the raise because he was not wearing a safety belt. The technology was up-to-date, the men experienced, skilled, and able to speak and understand English. Also, the employment (1,008) was far below the value that would produce five fatalities (2,004). In four of the accidents (the exception is the broken bolt), it could be said the men killed (or their fellow workers) were "careless" but their carelessness constituted not following the stated safety rules and regulations of the mining company. This unfortunate, multiple fatality year is an excellent illustration of the essence of the philosophy of the Safety First Movement. Four of the five accidents illustrate that the fatality rate in the iron ore mines would have remained high had it not been for the Safety Movement. Adherence to the existing safety rules could have prevented them from occurring. With respect to blasting accidents, but applicable to all accidents, William Conibear had stated in 1936:

> We found that well-defined standards for the handling...of detonators and dynamite are guides pointing the way to freedom from many accidents...of course, like all standards, their effectiveness depends upon leaving no leeway for deviation from safe practice (p. 183).

Each piece of equipment could be thoroughly guarded, all dangerous places fenced off, and every conceivable hazard covered by a rule or regulation but, ultimately, accidents could continue to occur and lives could still be lost in the recovery of the iron ore. It is apparent that progress in the prevention of accidents could be made only by getting the individual to think safety.

As early as 1925, Frank O. Botsford had addressed the importance of individual attention to safety at the Lake Superior Safety Conference:

> Our first thoughts were wrong, 'stated Botsford.' Before writing our rules we should have sold the idea of safety to the men. We should have stimulated in the men the desire for a few rules to insure safe operations. We attempted to force the idea of safety on the man without taking into consideration his thought, or better, his lack of thought in the matter. Our miners in the pioneer days of safety could not see the need for safety rules and for this reason refused to accept them and abide by them (p. 291).

Conclusions and Recommendations for Further Study

What was the social cost of underground iron ore production on the Marquette Iron Range? Expressed in numbers alone, 309,423,209 tons of ore were produced and 957 lives were lost. Every 323,326 tons of ore cost one life. Of course, the total social cost extends much further; the loss of productivity, the economic and emotional impact on the immediate family and the impact on relatives and local organizations often called upon for support of orphaned children and widows who could not work. This, multiplied by thousands of workers in other industries across the country, raises the total social cost of early industrialization significantly.

Looking back at the factors that were proposed as the causes of fatal accidents on the Marquette Iron Range it can be seen that changes in three of them produced the most favorable results with respect to decreasing the fatal accident rate: (1) Laxity in mine discipline and lack of managerial control of the miners and mine operation, (2) Absence of any laws forcing the companies to employ only trained miners in the responsible and dangerous occupations or to provide inspection of mines or mine equipment to ensure safe working conditions, and (3) Lack of any laws forcing

compensation for fatalities by the employer. Changes in these factors, brought about by conditions that stimulated the Safety First Movement, saved the lives of many miners. If the average fatality rate had continued to be what it was in the first three decades of mining during which a rate could be calculated, then 344 more miners would have died, a total of 1,301 rather than 957. This represents a substantial decease in the social cost of mining on the Marquette Iron Range.

Considering the stimuli for the Safety Movement three things stand out clearly:

(1) In our society ultimate control of the conditions of employment, including working conditions, rests with the employers. Therefore the fatality rate did not drop significantly until the owners and operator of the mines, the management, took an interest in reducing it. Only then could the importance of safety be communicated to the workers.

(2) The human element is a major factor in accidents and therefore the cooperation of the workers was necessary for the Safety Movement to become effective. How this cooperation was to be gained constituted a significant part of the safety problem. This is illustrated today in the Ukraine which has the world's highest coal industry death rate. The death rate is mainly blamed on two factors, (1) miners' neglect of safety rules, and (2) outdated equipment (*Flint Journal*, Tuesday, May 25, 1999). The existence of industry standards, rules and regulations, and state or federal laws does not guarantee that they will be obeyed by the workers. Therefore, enforcement and discipline are part of the preventative process.

(3) Constant vigilance is necessary in order to maintain the successes of preventative practices. This can be seen from the five fatalities that occurred in 1967 on the Marquette Iron Range.

In 1992 the first Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries was implemented in all 50 states and the District of Columbia (Toscano and Windau, 1993, p. 41). The Census reported 6,083 fatal occupational injuries (Toscano and Windau, p. 45). In 1997 the BLS Census reported 6,218 fatal occupational injuries (Jacobs, 1999, p. 348). These figures represent a vast improvement over Frederick Hoffman's estimate of 25,000 workplace deaths in 1915. However, regardless of the policies designed to prevent them, over 6,000 fatal workplace injuries probably occur in the United States each year and between 1992 and 1997 there was actually an increase of 135 fatal accidents per year.

The reason that this number of fatal accidents continues to occur is related to the lack of information on the causes and is best summarized by Toscano and Windau;

> It has been stated that policy can be made without data but that a better policy can be made with data. Indeed, data are part of the solution for injury prevention.
>
> Many safety experts regard fatal work injuries as sentinel events in that their occurrence indicates a failure in preventive practices. Unfortunately, the safety and health community has lacked the basic information needed to assess the full scope of these tragic events (pp.44-45).

For this reason, a study of the causes and remedies of fatal mine accidents is essential. Even though they occurred decades ago, an analysis of their causes adds to the empirical basis from which basic information needed for prevention can still be drawn.

The accumulation of data pertaining to the causes and remedies of fatal accidents becomes even more pertinent as President Bush and Senate Republicans overturn Clinton administration rules that protected workers against injuries from repetitive motion. While these are not fatal injuries, the move by the present administration is a step in the wrong direction and in itself will create an increased social cost that society has to bear. This research has shown that it is the lack of exactly these types of rules that result in an increase in workplace accidents, non-fatal and eventually fatal.

This study has concentrated on fatal mine accidents on the Marquette Iron Range. There has been no comparison among the three Michigan Ranges. Valuable information could be obtained by comparing the Marquette Range fatal mine accident history with that of the Gogebic and Menominee Ranges. This would help to; (1) refine the data pertaining to the causes and remedies of fatal mine accidents in Michigan, and (2) further assess the role of the Safety First Movement in making the mines safer.

A comparison of the Marquette Range fatal mine accident history with that of a different mining industry over the same period of time but in a different social setting would provide further information on the causes and remedies of fatal accidents. It would also aid in analyzing the connection between the Safety Movement in the steel industry and that in the iron mining industry. It would provide interesting data pertaining to the spread of the Safety Movement into those mining industries not connected to the steel industry.

A study of the fatal accident history in two different industries, iron mining and railroading in Michigan, for example, would reveal whether the same or different

causes and remedies of fatal accidents were involved. This would be more difficult because the physical conditions of the workplace would have to be normalized in some way. However, the information gleaned would have more general application in the prevention of fatal work accidents.

With respect to the Marquette Iron Range alone, an in-depth study of just one mine throughout its working life would be valuable. The type of technology and the timing of its introduction, the mining method(s) used, detailed employment data (number employed, age, nationality, days worked, wages), history and timing of unionization, and fatality data could be analyzed to produce a clearer picture of some of the relationships noted in the present research.

APPENDIX

APPENDIX

ADDITIONAL QUOTATIONS

Chapter 7

Pages 88-89

"The Republic Mine is one of the safest in the peninsula, taking its' size into consideration (*Ishpeming Iron Agitator/Ore*, July 29, 1882).

Champion is one of the handsomest and most delightful mining locations in the upper peninsula. The school houses, churches, townhall, and library are a credit to a city of 10,000. Clean, nice places, two well kept hotels, and a well built sidewalk longer than one mile (*Ishpeming Iron Agitator/Ore*, June 29, 1889).

There is a new hospital at Barnum Mine (*Ishpeming Iron Agitator/Ore*, October 19, 1889).

The alleys here are filth laden—boxes are used for vegetable matter—slops; need a sewerage system (*Ishpeming Iron Agitator/Ore*, June 14, 1890).

Residents of American Mine are throwing slops and garbage into the county road in front of their homes. This is illegal (*Ishpeming Iron Agitator/Ore*, December 12, 1891).

While there are a few complaints heard from the men who work in the mines, the companies will give them a just share of the gain, and this they will do of their own accord, a rule they have ever practiced in this mining region, and one which is a credit to their sense of justice and fairness...This region is blessed with a good class of labor which ought to be maintained according to their capacity, and it also has one of the most liberal lot of mining companies to be found anywhere...This is a region of many advantages in the way of public schools, churches, municipal benefits, libraries, water, lighting, highways, and numerous other features which add to the comforts of home and its surroundings, which elevate the mind, educate the rising generation and give a true insight into American independence... (*Michigan Miner*, 1900, p. 22).

Pages 90-91

It's unbelievable the way lighting changed in the mines. First there was candles with a spur on it so you could take it out of your hat and stick it on a post or timber...If you were in a drafty place you had a hard time keeping them burning. You had to go down the tunnel backwards so the wind wouldn't blow out your light. They were afraid of fire so they had torches in very few places...there isn't any place in the world where it is such total darkness... (Bernhardt, 1975, no pagination).

When I was a kid...I used to help the old dry man give out sunshine balls. The lamp looked just like a coffee pot hanging from your hat, but smaller. Sunshine came in big balls and you put it in hot water so it would get soft like lard, then you'd take a cup and put it in the lamp with a little cover on it. After that came carbide lamps and finally electric lights which lasted for twelve hours before you put them back on the charging station. In the old days, though, it was just as well that you couldn't see (Bernhardt, 1975, no pagination).

...The dry was a building where the men changed, because when they came up they would be soaking wet with iron ore water...You could always tell a miner's home because of the red underwear. It started out white but it ended up being red even after it was washed. In fact all of the clothes they wore underground would be dyed that hematite color (Bernhardt, 1975, no pagination).

There was a strangely subdued almost funeral quietness in the room. This was noticeable whenever there has (sic) been news of an accidental death at one of the company properties. In folk lore, it portended God-awful consequences because accidental deaths...are suppose (sic) to happen one following closely behind the next and in clusters of three. The spooky question is, who will be the next to go? As I remember, it was the day when two men working at the Mather A Mine...were literally evaporated when boxes of dynamite accidentally detonated... (Etelamaki, 1998, p. 85).

...what about the man who takes a job which requires him to drop thousands of feet down into a dark hole while packed into a metal box like sardines in a can and at the other end in the engine house some distance away another mistake prone imperfect human like yourself has the levers in his hands that control destiny while (you) ride down to (your) work place deep within the bowels of the earth. Otherwise, if it wasn't for the lure of money, only a half wit would take that ride (Etelamaki, 1998, p. 89).

In my experience, driving rock drift (making a tunnel in rock) was the most hellish of all places to work...Compared to any other job the primary attraction of working in a rock drift was the opportunity to earn bonus pay...It was the night-marish conditions with the rock drift that now brings (sic) me to write about it...While drilling a pattern of holes preparing for the blast, one had to contend with the deafening racket made by two large pneumatic drilling machines...Then there was the fog like mist mixed with oil which spewed from the exhaust of the machines and like working in a dense fog vision was limited. The heavy oil necessary to lubricate the drilling machines...clogged the dust collecting pads in respirators. It made no sense to change pads because they would clog up in a short time. Usually the respirator was a nuisance even when it did what it was intended to do.

The company issued two piece wet suits that shed the water coming in from the outside but it also kept the sweat inside.

Safety goggles were mandatory, but in that fog and mist,...they were practically more a threat to the miners safety than they were as protection of his eyes (Etelamaki, 1998, pp.91-93).

What condemns man to work in these conditions. First, there is the matter of a paycheck. Second, there is the matter of the paycheck. Third, no doubt many miners, like myself, thought of running away but the lure of money and being the bread winners in the family, the whip of necessity kept us coming back...Finally, most miners will agree, in these parts the mines were not the worse place to work (Etelamaki, 1998, p. 93).

Down in the mine, one was made consciously aware of his mortality. I quickly add, not to the extreme of being frozen stiff with fear. The thought seemed to lurk a hair below the consciousness level. With a little experience like a combat veteran, one learned not to fight reality but to make adjustments to deal with it. In truth it wasn't the most hazardous occupation in the world. Regardless, it took a little more courage to grab hold of the lunch pail at home and go to work in the mine than it was (sic) to go to a two martini lunch with a group of white collar workers (Etelamaki, 1998, p.).

Pages 92-93

From the *Ishpeming Iron agitator/Ore:*

Edward Lamrew, age 40, an Englishman, was killed by a fall of ore at Milwaukee Mine (February 7, 1880).

David Little, aged 40, was killed at the New York Mine after being hit by a rock falling from the roof (May 1, 1880).

Joseph Belandley, a French Canadian, was killed by a fall from a platform at the Winthrop Mine (May 22, 1880).

11 died when Lake Superior Powder Company blew up (September 10, 1881).

More than 2,000 railroad workers were killed and 1,230 crippled last year for lack of a safe coupler (November 18, 1882).

The volcanoes have killed 100,000 people in the last month (September 15, 1883).

More than 100 men and boys killed in hunting accidents in the last six weeks (January 7, 1882).

A miner died of smallpox (January 14, 1882).

A man age 22 died of scarlet fever (April 8, 1882).

Chapter 8

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From the *Ishpeming Iron Agitator/Ore:*

Ole Olsen, a Swede, aged 26, was killed at Lake Superior Mine by a fall of rock. He worked there 3 or 4 months (November 20, 1880).

Thomas Ryan, aged 21, was killed when he fell in a stope at the Cleveland Mine. He had worked there a short time after coming from Vermont (January 15, 1881).

Alfred Hopstadt died at Cleveland Lake Shaft. He walked into the shaft. He had worked there two weeks (September 19, 1891).

Charles Freethy was killed at the Salisbury on Monday by a fall of ground. He was 19 and had worked there 3 months (December 17, 1892).

Pages 131-132

From the *Ishpeming Iron Agitator/Ore:*

William Snell, aged 36, was killed when crushed by falling rock he was baring down at Jackson Mine...carelessness as he disobeyed orders (July 16, 1881).

John Magnuson, age 40, was killed when hit by a falling plank at Barnum Mine due to carelessness of himself (March 31, 1883).

3 men were killed riding in the skip—they knew it was against the rules, there are signs in the shaft house that state the rules but riding 530 feet is easier than walking. Men gain nothing by riding skips, it is forbidden; they risk their lives merely to avoid descending ladders as do hundreds of men daily (August 13, 1887).

Ed Olilla, age 18, was caught by a fall of rock at Cleveland Mine...and instantly killed. Work wasn't finished baring down ground—all knew it but he went there anyway. No one blames anyone (April 7, 1888).

Albert Hopstad died at Cleveland Lake Shaft...it was his own carelessness (September 19, 1891).

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