HISTORICAL GEOGRAPHY OF LEAD AND ZINC MINING IN SOUTHWEST WISCONSIN 1820-1920: A CENTURY OF CHANGE

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DALE ROGER FATZINGER

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ABSTRACT

HISTORICAL GEOGRAPHY OF LEAD AND ZINC MINING
IN SOUTHWEST WISCONSIN 1820-1920:
A CENTURY OF CHANGE

By

Dale Roger Fatzinger

This study examines the evolution of the mining industry of southwest Wisconsin under European settlers of the early nineteenth century and traces its continuing development to the year 1920. Grant, Iowa and Lafayette counties, long the most productive parts of the Upper Mississippi Valley Lead and Zinc District, constitute the study area. The basic question that has been raised is: How has the geography of mining changed in southwest Wisconsin between 1820 and 1920? Considered concomitantly is the question: What has been the impact of the activity on the region?

Primary sources in the form of government documents, correspondence, diaries, maps and atlases, census publications, and local newspapers provided contemporary data and accounts of mining activity, and were relied upon heavily in this work. In addition interviews were conducted with persons directly acquainted with the industry during the late 1800's and early 1900's. These yielded much valuable information.

The century of mining examined is divided into three time periods. The first, pre-1860, is analyzed in Chapter I. During this early time the miners were seeking lead ore and the activity was primitive and not well organized. Still, the ores were found easily and in abundance, allowing the study area to become the young nation's leading producer. The easily mined surface lead deposits became depleted by the end of the period, but mining continued sporadically, attempting to

recover ores at greater depths. Zinc was known to exist, but not utilized in spite of a considerable national demand for the product. This latter paradox is examined in detail.

Chapter II studies the time period 1860-1895 when zinc became the principal object of the miner's search. Considerable change was evident in various aspects of mining and processing of the ores, but the mining industry of southwest Wisconsin was still considered to be relatively backward among mining men from other areas. Very important, during this era, were the inter-relationships between the region's mining activity and other elements of the region. Particularly significant were ties between the mines and the development of the areas rail net, and between the mines and the establishment of huge local zinc smelters.

The third and final time span studied is 1896-1920, covered in Chapter III. Some of the problems which had hindered mining in the previous period were remedied. Notably the difficulty of processing the local ores due to the intimate mixture of zinc with iron pyrites was overcome by roasting and magnetic separation. This improvement along with others such as deeper mining, greater mechanization and more non-selective mining, to name a few, coupled with higher prices, resulted in a period of boom times and prosperity for southwest Wisconsin. Unfortunately, Wisconsin was a marginal producer of zinc, and when demand for the metal declined after World War I with a resultant decrease in prices, the study area's mining industry went into a rapid decline. By 1920 the activity was in one of the severest depressions it had ever known.

This dissertation has revealed that great changes took place in local mining activity during the century of study - changes in the cultural characteristics of mine workers and their working conditions, in the techniques of mining itself (exploration, mine opening, underground development, transporting ore to the surface), in ore processing methods and in mine company organization. Many of these changes were in the form of improvements that were brought about to rescue the industry when it seemed to be dying. This happened many times in the area. Significant inter-relationships between the development of mining and elements of the local region were also discovered. Some of the major ones involved the physical landscape, political influence, industrial development, economic development in general, transportation, and population growth and character. Strong interaction also occurred between southwest Wisconsin's mining industry and outside elements such as mineral prices and demand, location of smelters, availability of capital, and influence of national corporations.

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By

Dale Roger Fatzinger

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This dissertation is dedicated to Paul Cross Morrison - scholar, teacher, and friend.

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Dr. Daniel Jacobson deserves special thanks for agreeing to become thesis advisor and doctoral committee chairman for the author, after the death of Dr. Morrison left a vacancy in those areas. The enthusiasm, encouragement, and friendly advice provided by Dr. Jacobson have been most sincerely appreciated. Truly he is responsible for the bringing of this work to fruition.

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Introduction

Since the early 1800's mining has been significant on the landscape and in the lives of the people of southwest Wisconsin. At first lead and later zinc provided significant contributions to local economic development. The mining industry of the region was prominent on the national level too; for many years it ranked at the top or among the leaders in zinc and lead production.

The main objective of this dissertation is to analyze the evolution of mining in southwest Wisconsin. The basic question to be answered is, "How did the geography of lead and zinc mining in southwest Wisconsin change between 1820 and 1920?" Concomitant to the primary objective is the task of determining the impact of the industry on the character of the region. The problem involves both examination of the activity, describing and interpreting its distinctive features, and investigation of the area's physical and human organizational patterns in terms of how they affected mining and in turn were influenced by it through time.

The methodological framework used in the study is derived from both economic and historical geography. The dominant point of view is that of an industry - the mining industry - in a regional and temporal setting. Economic geography studies the relationships between man and his total environment (physical and human) in his productive labors to satisfy his wants and needs. The geography of mineral production is one aspect of the broad field of economic geography. The author has

attempted to apply the conceptual framework of economic geography to one activity - namely mining - in a limited area, just as it has been done, but with more frequency, in other economic endeavors, i.e., agriculture and manufacturing. Within this conceptual framework three attributes of the past mining industry of Wisconsin are stressed. They are: (1) its location, (2) its characteristics, and (3) its relationships with the natural and cultural environment. In the analysis of relationships, recognition is also made of the linkages that existed between the spatial variables within the region, and those that existed between it and outside regions.

Although stated as the concomitant objective, the impact of mining on the area of southwest Wisconsin is truly inseparable from the main objective of analyzing the geography of the industry. The dissertation deals primarily with the activity of mining, but to be geographic the study must place the industry in an areal setting, and take cognizance of the total geographic complex of the region and the spatial interaction that occurs there. In truth this is the heart of any geographic study. A geologist or a mining engineer could also make a study of mining in Wisconsin but the final results of such a study would be considerably different from those achieved in this dissertation in that they would be much less concerned with the interaction between the mining industry and the other geographic elements of the region.

The dissertation is also a study in historical geography. The "raison d'etre" and "modus operandi" of historical geography have been well defined in the writings of Hartshorne, Sauer, Clark, Brown and others, and have been generally acceptable to our profession. To this

writer an excellent definition of historical geography is the re-creation of past geography. It has been argued above that it is, and has been, legitimate and respectable for a geographer to study one economic activity, under the framework of economic geography. Thus, it is perfectly proper for a geographer to re-create the geography of one economic activity through time, under the framework of historical geography. "Any study of past geography or of geographic change through time is historical geography, whether the study be involved with cultural, physical, or biotic phenomena and however limited it may be in topic or area."[1] In this study mining is analyzed as it developed through time as well as in space. Such a re-creation of economic geography during past periods satisfies the conceptual framework of historical geography.

The areal setting is the Tri-County region of southwest Wisconsin, composed of Grant, Iowa, and Lafayette counties. The mining region is not coincidental with the political boundaries of these three units (Map 1), even though in local and statewide useage the terms "Lead Region" or "Lead and Zinc Region" have been applied to the three counties in their entirety. The actual mining district in fact extends eastward into Green County, westward into northeast Iowa (Dubuque County) and southward into northwest Illinois (Jo Davies County). This entire mining region is commonly referred to as the Upper Mississippi Valley Lead and Zinc District. The focus of this study, however, is on the Tri-County region of southwest Wisconsin, since that area includes by far the greater part of the district, and historically it has been the most important producer of lead and zinc.

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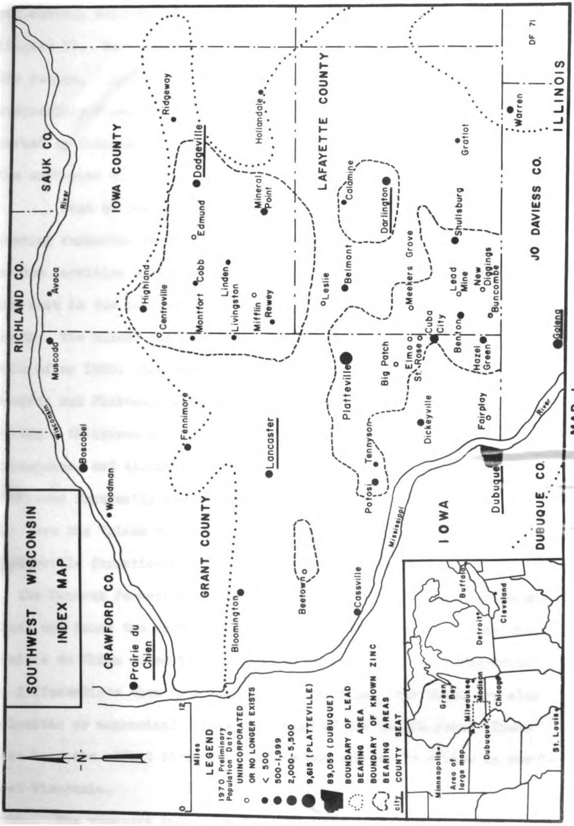
[1]Andrew Clark, "Historical Geography," American Geography Inventory and Prospect, ed. Preston E. James and Clarence F. Jones (Syracuse: Syracuse University Press, 1954), p. 71.


SOUTHWEST WISCONSIN
INDEX MAP
RICHLAND CO.
SAUK CO.
CRAWFORD CO.
IOWA COUNTY
GRANT COUNTY
LAFAYETTE COUNTY
JO DAVIESS CO.
DUBUQUE CO.
ILLINOIS
IOWA
Wisconsin River
Mississippi River
Prairie du Chien
Woodman
Boscobel
Muscoda
Avoca
Ridgeway
Hollandale
Dodgeville
Edmund
Mineral Point
Highland
Centreville
Montfort
Cobb
Linden
Livingston
Mifflin
Rewey
Fennimore
Lancaster
Beetown
Bloomington
Cassville
Potosi
Tennyson
Platteville
Dickeyville
Big Patch
Elmo
St. Rose
Cuba City
Benton
Hazel Green
Fairplay
Leslie
Belmont
Calamine
Darlington
Meekers Grove
Lead Mine
New Diggings
Buncombe
Shullsburg
Gratiot
Warren
Galena
Dubuque
Miles
0
12
LEGEND
1970 Preliminary Population Data
UNINCORPORATED OR NO LONGER EXISTS
< 500
500-1,999
2,000-5,500
9,615 (PLATTEVILLE)
89,059 (DUBUQUE)
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREAS
city COUNTY SEAT
Minneapolis
Area of large map
Green Bay
Milwaukee
Madison
Dubuque
Chicago
St. Louis
Detroit
Cleveland
Buffalo
DF 71
MAP-1

The bedrock of the area consists entirely of relatively soft sedimentary deposits laid down in the early part of the Paleozoic Era (Figure 1). No igneous or metamorphic rocks are exposed anywhere in the region, although some have been reached by very deep borings. The sedimentary rocks are found in almost flat layers, only slightly disturbed by folding or faulting. There is a gentle dip of the strata to the southwest at a rate of about seventeen feet per mile (Figure 2).

Most of the surface is underlain with the important mineral bearing formation known as Galena dolomite. This massive, thick bedded formation averages about 200 feet in thickness, ranging from 100 feet in the northern end of the district to about 275 feet in the south. The Galena was the only formation mined to any extent until well after 1900. Underlying the Galena are weaker sedimentaries, the Decorah and Platteville formations (together formerly called Trenton) having a thickness of thirty-five to seventy-five feet. These shales, limestones, and dolomites, include two members whose local names are mentioned frequently as boundary zones in the early mining literature. They are the "glass rock" which is the Quimby's Mill member of the Platteville formation and the "oil rock" which is the Guttenberg member of the Decorah formation. Beneath the Platteville and Decorah formations are found the soft, light colored St. Peter sandstone and the Prairie du Chien dolomite (together formerly called Lower Magnesian to differentiate them from the three upper formations which are also dolomitic or magnesian) with a thickness of 280 to 320 feet. These have been the oldest formations of any consequence to mining in southwest Wisconsin.

The youngest rocks are the Maquoketa shale and Niagara dolomite.

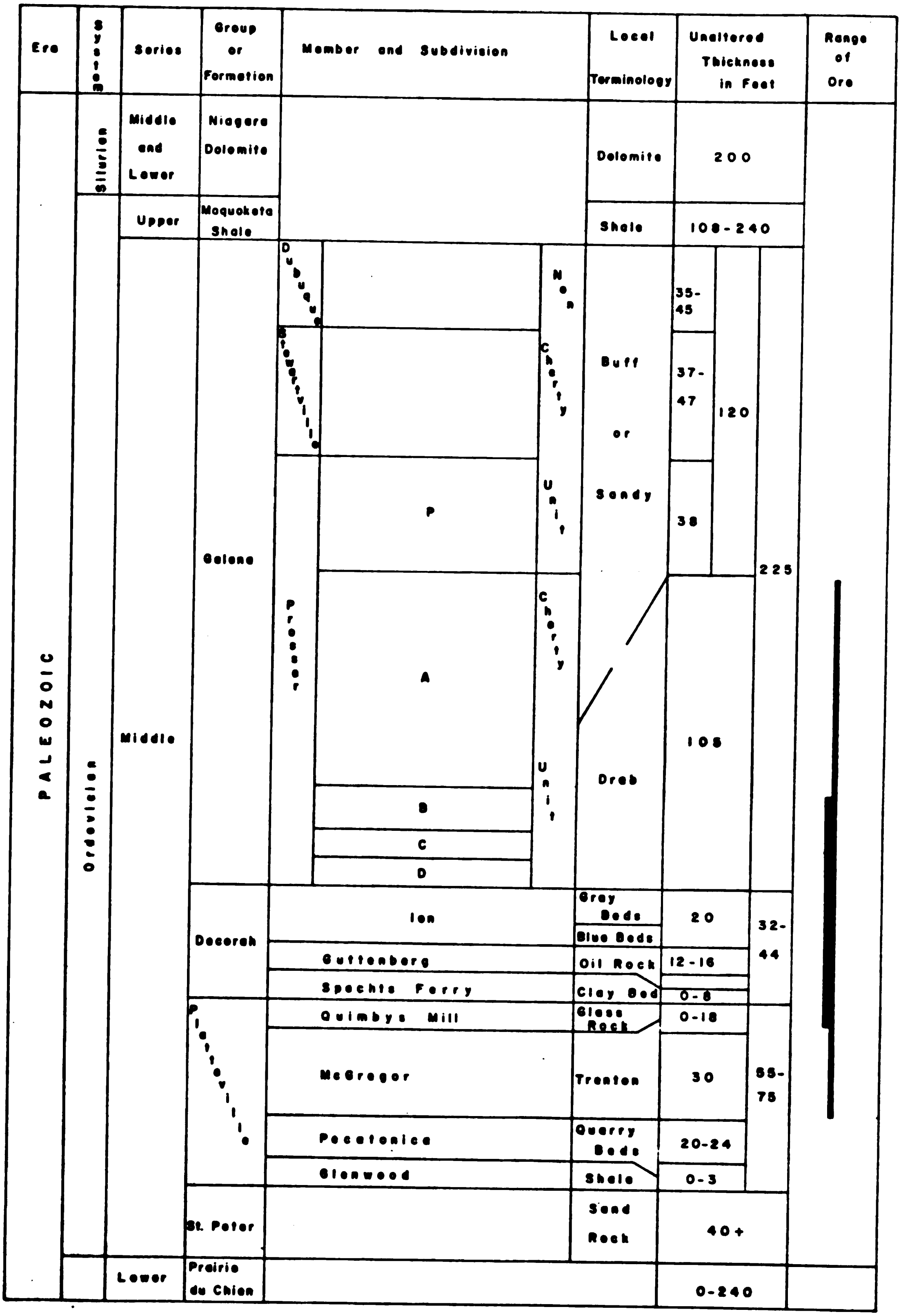
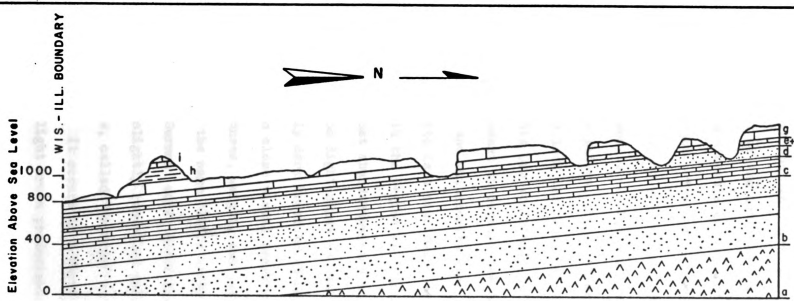


FIGURE 1. GEOLOGIC COLUMN OF SOUTHWEST WISCONSIN

Adapted from Heyl, et al. <u>The Geology of the Upper Mississippi Valley Zinc-Lead District</u>, 1959, figs. 2 and 3



a-Pre Cambrian

b-Cambrian Sandstones

c-Lower Magnesian Limestone

d-St.Peter Sandstone

e-Platteville Limestone

f-Decorah Limestone

g-Galena Dolomite

h-Maquoketa Shale

i-Niagara Dolomite

DF 71

FIGURE 2. PROFILE OF SOUTHWEST WISCONSIN STRATA

These formations are found only in the mounds of the region. Neither of these rock layers contained ores of any significance.

As a result of the numerous geological studies made of southwest Wisconsin, the minerals of the district were well identified by the 1870's. The major primary minerals are galena (PbS), sphalerite (ZnS), pyrite (FeS_2), and marcasite (FeS_2). The chief secondary minerals are smithsonite ($ZnCO_3$) and iron oxides.

Galenite or galena, the sulphide of lead (lead 86.6, sulphur 13.4), was the only lead ore found in sufficient quantities to be of economic value. This ore was simply called "mineral" by the early miners and was abundant throughout the district.

Sphalerite and smithsonite have been the two zinc ores utilized. Sphalerite is a zinc sulphide (zinc 67, sulphur 33) and is commonly known in the region as "blende," "blackjack," or "jack." It is one of the most abundant minerals of the region. This mineral varies in color from light straw yellow through brown to jet black but is predominantly dark brown to black. It is similar in appearance to galena (although close visual examination reveals significant differences in hardness, weight, and luster), in fact this similarity is responsible for the name blende being given to it. "It derives its name from the German word blend meaning blind or deceptive, because, while it slightly resembles galenite, it yields no lead."[2]

Smithsonite, called "drybone" (or "bone") locally, is the carbonate of zinc. It occurs in a variety of colors, with white, yellow, gray, and light brown predominating. Since it was a well known

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[2]Moses Strong, "Lead and Zinc Ores," Geology of Wisconsin, 1873-1879, ed. T. C. Chamberlin (Madison: David Atwood, 1883), I, p. 641.

fact by the late 1800's that the drybone diggings were usually free from water, and that the zinc ore below the water level was blende, it was correctly assumed by geologists that the smithsonite was a result of the decomposition (work of the atmosphere and water charged with carbonic acid) of the sphalerite. Drybone was found most extensively in the central and northern parts of the district. When pure the drybone contained 52% metallic zinc.

Marcasite and pyrites (iron 46.7, sulphur 53.3) are common iron sulphides in the district, and are generally called sulphur by the miners. These minerals have usually been found in close association with the zinc ores.

A variety of other minerals and ores exist in the region but have little or no significance in the development of the mining industry.

The landscape of the "Lead Region" is beautiful to the eye, even after nearly one and a half centuries of use and mis-use by man. It is composed of rolling, tree covered hills, sharp-featured forested valley sides and bluffs, and relatively flat, cultivated upland surfaces and valley floors. It is blessed with a temperate climate and generally deep and fertile soils.

Although it was inhabited by Indians for untold centuries before, white men did not come to the area to settle until the 1820's. On the basis of rich mineral and agricultural resources, the region developed rapidly. Its wealth and importance led to Wisconsin gaining territorial status in 1836 and contributed to the achievement of statehood in 1848. Southwest Wisconsin's prosperity has continued and even today it is noted for its agricultural productivity. Culturally the Tri-County region has been influenced by several sources. At first large numbers of settlers

came from the South. Big groups of Germans and English (including Welsh and Cornish) followed. Many Scandinavians also came. During the early part of the present century, following a general national trend, southern and eastern Europeans arrived to further complicate the cultural cast. The northwest European element, however, has been strongest in the human imprint on the area.

This dissertation is concerned with three main time periods: (1) 1820-1859, (2) 1860-1895, and (3) 1896-1920. The year limits of these periods were chosen arbitrarily on the basis of significant changes in the character of the mining industry.

Chapter I is an analysis of the nature of the earliest mining activity in southwest Wisconsin, prior to 1860, and its relationship to the over-all development of the region. This preliminary period, when the concern was solely with producing lead, was extremely important in setting the stage for the development of zinc mining which followed. The chapter also examines the status of zinc in the mining industry of that time. Its discovery, lack of utilization, and potential are discussed.

The second period, 1860 to 1895, is dealt with in Chapter II. It is the one in which zinc was first utilized, but the industry continued to feature many of the primitive conditions of the earlier Lead Era. The nature of mining and processing zinc changed greatly in the late 1890's and early 1900's; there also was a large increase in national and international demand for the metal. These factors resulted in boom times and expanding production for the zinc region which culminated just before 1920. These years, 1896 to 1920, are the subject of Chapter III. In the final chapter, Chapter IV, the changes within

the mining industry and its impact on the area during the first century of its existence are summarized.

The study is based upon two investigative tools, namely library research and field work. The resources of the Karrmann Library at the Wisconsin State University - Platteville and the Library of the Wisconsin State Historical Society in Madison were used exhaustively. Both libraries contain large collections concerning southwest Wisconsin. In addition to secondary materials in the form of books and articles, a varied and large number of primary sources were found and utilized in the libraries. Included were federal and state documents, maps and atlases, diaries, correspondence, business records, and interview tapes. The newspaper collections of these libraries were extremely useful. The writer surveyed microfilm copies of the Grant County (Platteville) Witness of 1859-1919 and the Platteville Journal of 1917-1920 to gain a contemporary view of the area's mining activity during the 100 year period studied.

Field work consisted of interviewing persons with first hand information about the mining industry, past or present, and visiting active and abandoned sites of mining activity and associated phenomena. In all twenty-two interviews were held, hundreds of miles of driving were completed, and the area was flown over to accomplish this part of the study. The field work enabled the writer to more clearly visualize the mining activity of the past and its relationships to the physical and cultural phenomena of the area. Observations made and pictures taken in the field emphasized the changes which have occurred in the region's geographic landscape.

CHAPTER I

THE MINING INDUSTRY BEFORE 1860

Mining activities were very significant in the early settlement of the Tri-County area and in the economic and political development of Wisconsin in general. Although the first populated centers in Wisconsin were located at Green Bay and Prairie du Chien, these were primarily military establishments and contributed little to the subsequent development of the state. It was in southwest Wisconsin that the state's first economic boom occurred. The resulting prosperity and increased settlement in this area led directly to the establishment of the Wisconsin Territory in 1836 and later aided in the Territory's organization into a state in 1848. The initial attraction for the early settlers and the basis for the economic prosperity which followed was lead ore.

The Lead Mining Era

Beginning in 1824, with the founding of the first towns, lead was king in southwest Wisconsin for thirty years. This is not to imply that there was no mining for galena before 1824. Quite to the contrary, it is believed that the existence of these Upper Mississippi Valley lead deposits were known to the French shortly after the Mississippi River itself was discovered.

Historical perspective

Lead was mined and traded intermittently by the French and Indians from the late 1600's until the early 1800's, when the Americans came into the region.[3] The most famous of the early Frenchmen connected with lead was Julien Dubuque whose headquarters was located where the Iowa river-city named for him now stands. He held a virtual monopoly on lead shipments between 1788 and 1808, the year of his death. His activities were centered in eastern Iowa along the Mississippi River, but much of the lead was brought to him by Indians from southwest Wisconsin.

> It is a fair inference that the Indians had themselves operated the lead mines after a crude fashion fully a century before Dubuque's time. But . . . this was doubtless only to get bullets for guns . . . and to furnish the fur traders with a commodity as desireable as peltries.[4]

Evidence of Indian mining of lead after Dubuque's death is given in a report by a federal Indian agent stationed at Prairie du Chien. He wrote to the Secretary of War in 1811 that the Indians "have mostly abandoned the chase, except to furnish themselves with meat, and turned their attention to the manufacturing of lead which they produce from a mine about sixty miles below Prairie du Chien."[5]

In the early period, lead was primarily an adjunct of the fur trade, and this situation continued until the settlement frontier reached the mining region. The United States government acquired

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[3]R. G. Thwaites, "Notes on Early Lead Mining in the Fever (or Galena) River Region," Wisconsin Historical Collection, XIII (1895), pp. 271-292.

[4]Ibid., p. 280.

[5]C. E. Carter, The Territorial Papers of the United States. XVI, The Territory of Illinois, 1814-1818 (Washington: Government Printing Office, 1948), p. 156.

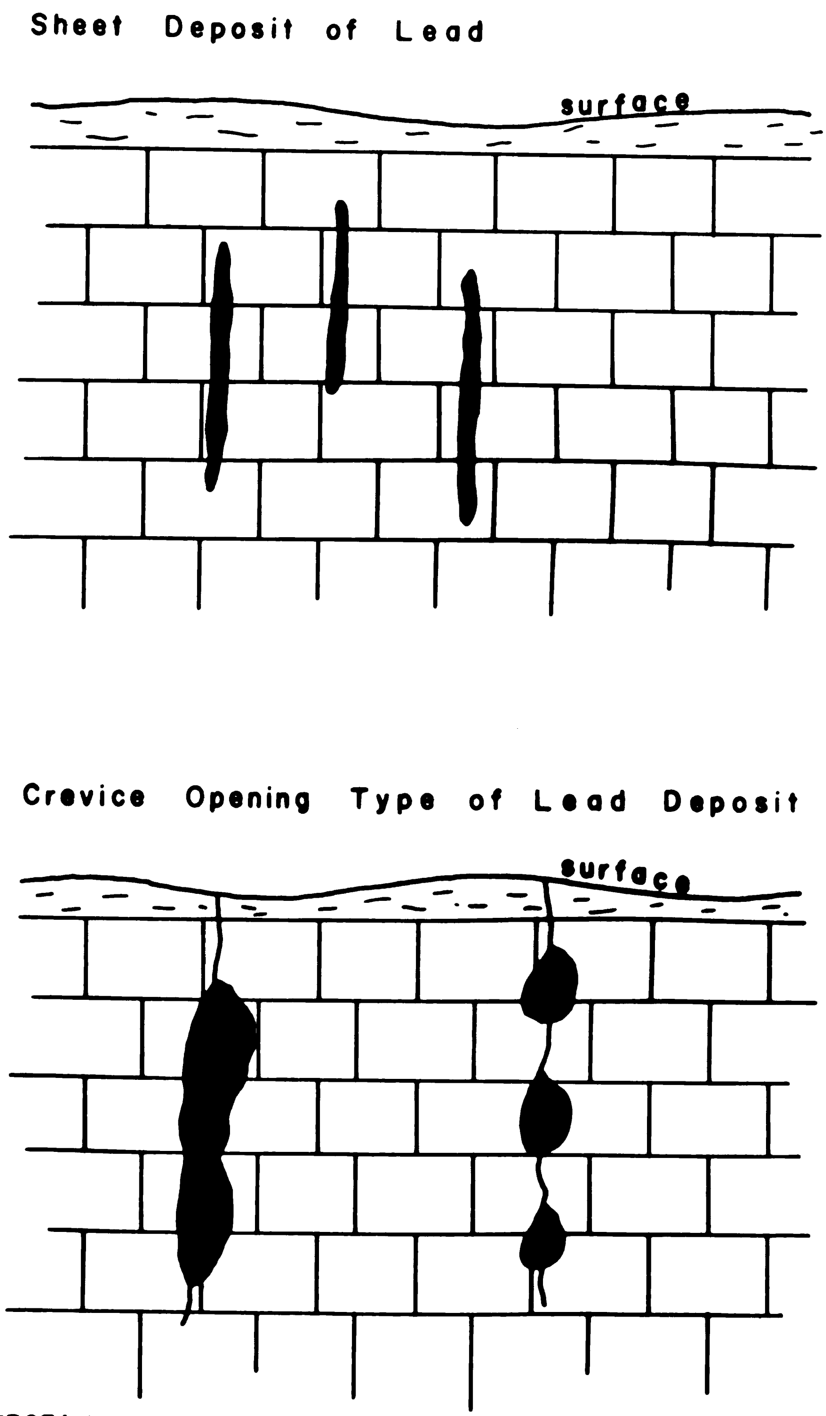
title to much of the land of the Lead Region between 1804 and 1815. Permanent settlement began around La Pointe (later to become Galena, Illinois) in 1819. Only then did mining become independent of the fur trade. Soon the fame of the area's mineral wealth became known far and wide. The settlers prospered, new mining tracts were opened, and La Pointe became the recognized center of the Fever (Galena) River mining district. As time passed hundreds of migrants arrived and at first were concentrated around La Pointe. Because of crowded conditions there, however, and the inability of the mines to satisfy the ever increasing demand for lead, they expanded their activities northward into what is now Wisconsin.

The lead mining operation

Two factors which assured an economic boom and the beginning of permanent settlement in Wisconsin were the large and easily recovered lead deposits and a great national demand for lead.

Nature of the deposits.--Although the ore was to be found in many geologic horizons, the largest quantities were taken from the easy-to-mine deposits in layers of bedrock just below the surface. The nature of the deposits also favored mining. The simplest form was the sheet - a thin mass of ore occupying a vertical or nearly vertical fissure in the rocks (Figure 3). A second type, the crevice, as followed down from the surface, would usually be a mere seam or fissure in the rock with hardly a trace of ore in it. Then, either suddenly, or gradually, it would widen and form an ore-filled cavity (Figure 3).

The essential difference between the sheet and crevice deposits was that in the latter, the ore was distributed as chunks of metal in loose, weathered material. Thus, it did not require blasting but could



SOURCE: Hall & Whitney, Report on the Geological Survey of the State of Wisconsin, I, 1862.

FIGURE 3. Main Types of Lead Deposits

be shovelled out like dirt.

Prospecting, mining and smelting lead.--The methods of finding, recovering and processing the ore were very simple. At first, in prospecting, evidences of former Indian diggings were sought. As these became scarce the search turned to "float ore" (mineral occurring loosely in the soil) or to faint surface depressions or excessive growth of weeds or grass. The depressions or vegetation excess often marked the location of crevice deposits.[6]

After the ore was found mining began. A recollection of the lead mining activity during the 1850's is provided by an early resident of the Lead Region:

> On all sides of the town [Platteville] the mining industry was carried on in a primitive way and mineral holes abounded everywhere. They were well-like excavations sunk for lead ore. The ore mixed with earth, was lifted in buckets operated by a hand windlass; when the vein of ore was exhausted the digging stopped and the hole was left open. . . . The holes varied in depth from a few feet to twenty or thirty feet. . . . As I remember it the lead ore that was mined was taken to a smelter [local furnace] and melted and run into a mould of certain dimensions and came out pig lead in which form it was then taken to the market.[7]

The shallowness and manner of occurrence of the lead ores did not necessitate a complicated or expensive system of mining. In fact, the miners themselves recorded this condition by referring to their workings as "diggings" and not mines, e.g. Hardscrabble Digs, Cave Digs, Irish Digs, New Diggings (Map 2). A man working alone could easily produce large quantities of ore by simply digging. One John

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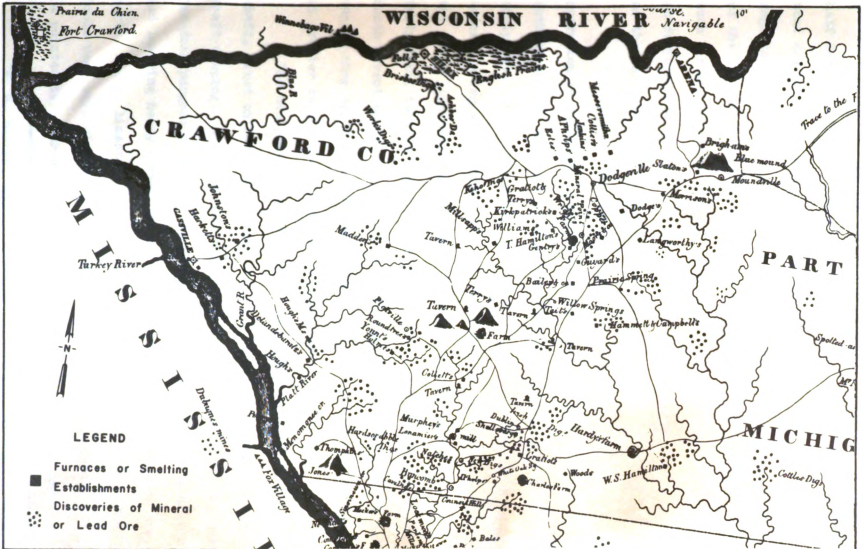
[6]Moses Strong, op. cit., p. 647.

[7]M. G. Douglass, "Personal Recollections of Platteville," Wisconsin Magazine of History, VI (1922), p. 58.



A Portion of the 1829 Edition of R.W. Chandler's Map of the Upper Mississippi Valley

MAP-2

Bonner sank a shaft in the Hazel Green vicinity and at four and one half feet found lead extending all over the bottom of the hole. The next day he took out 17,000 pounds of lead ore.[8] Such a story of rags to riches overnight was repeated many times in the early days of the Tri-County region, and it is not difficult to understand why such a rush of people into the area took place. Not all miners were as fortunate as Bonner, and this type of "mining" soon came to an end as the surface deposits were depleted.

Two or three men working together would have a longer lasting operation by utilizing a little more advanced method of mining. The methods usually employed required virtually no capital and only meager equipment. The miners would sink a vertical shaft, four to five feet square, using wood cribbing as they went down to prevent cave-ins, until the solid limestone was reached. After digging to depths of thirty or forty feet, tunnels would be drifted from the main shaft in a north-south direction, since most of the lead veins ran east-west. In this manner they could take out the surface ore, but also utilize deposits at greater depths than could the single miner.

The equipment used included an ordinary two handled crank shaft, fixed on posts which were set on a wooden frame laid at the shaft opening. A strong rope was attached to the crankshaft and served the dual purpose of moving the miners up and down the shaft and hoisting and lowering heavy wooden tubs. The tubs were used to bring up the earth, shale, limestone, and finally, the miners hoped, lead. The tools used were simple and included the pick, shovel, crowbar, gad (a pointed iron bar or spike), hand drill, blasting powder and fuse.

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[8] H. R. Austin, The Wisconsin Story (Milwaukee: The Milwaukee Journal, 1948), p. 82.

The vertical shafts needed no artificial lighting; in the horizontal tunnels candles were used.

About the only serious problem the early miners faced, aside from running out of mineral, was water. This is referred to in both popular and scientific accounts: "The greatest drawback to mining in the early days was the enormous volume of water that flooded the mines below a certain level,"[9] and again:

> Water being very troublesome here [Hazel Green] the workings have usually been abandoned at a very shallow depth and although efforts have been made, and a good deal of money expended to drain portions of the ground by machinery, the result has been far from satisfactory.[10]

The problem was usually solved, as mentioned above, by abandoning the pits at the water table.

In many parts of the locality, diggings were carried on extensively within a rather limited area. The result being that in places the ground had been literally honeycombed to depths of twenty to forty feet, giving a rough and broken appearance to those surfaces under which cave-ins had occurred. Another result were the large waste piles, many of which even today dot the surface.

A traveller during the 1830's gives us a contemporary view of the mining landscape in two parts of the District: "I never enjoyed a more agreeable ride until we came within a few miles of Mineral Point. Here the hills were stripped of their trees, windlasses, mineral holes, piles of dirt, rocks and mineral greeted our

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[9] W. A. Titus, "Hazel Green, the Last Resting Place of a Poet," Wisconsin Magazine of History, XII (1928-1929), p. 296.

[10] James Hall and J. D. Whitney, Report of the Geological Survey of the State of Wisconsin (Madison: State of Wisconsin, 1862), I, p. 284.

view from all sides," and again speaking of the area near Gratiot's Grove: "It is true there were more settlements [than at Wiota], but the prairie was cut up by numerous mineral holes, piles of dirt and windlasses, which marred the beauty of the landscape, but showed great activity and industry."[11]

The lead ores as they arrived at the surface were sometimes sufficiently clean and pure to market them immediately. More frequently however, they needed processing. Sometimes all that was necessary was a simple washing to remove foreign matter. In other instances the ore had to be crushed and jigged, a process in which the heavier metal was separated from the lighter waste material by water agitation.[12]

The smelting operations carried on in the Lead Region were of two main types. The log and ash furnace was utilized on a wide scale until the 1830's and was then largely replaced by the brick and stone furnace.

Mr. Rodolf's Journal is the source of information on the contemporary smelting scene:

> The country around Galena for a distance of forty to fifty miles east and north was dotted with crude log furnaces for smelting the mineral. . . . The prairie was bounded on the south and west by a magnificent grove of oaks, the destruction of which had been however already begun, as the voracious smelting furnaces mercilessly claimed the sacrifice of the splendid trees which were the pride and joy of the Grove [Gratiot's]. . . . The latter [smelting works] were of the most primitive character and a very large percent of the lead was lost in the operation.[13]

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[11] T. Rodolf, "Pioneering in the Wisconsin Lead Region," Wisconsin Historical Collection, XV (1900), p. 348.

[12] Moses Strong, *op. cit.*, p. 649-650.

[13] Rodolf, *op. cit.*, p. 342-344.

The early method of smelting had been introduced by the Spanish and was being used by the Indians when the white settlers arrived.[14] This technique consisted of digging a hole on sloping ground, two feet deep and two feet wide. A short way down the slope, a tunnel about one foot wide was dug in to the bottom of the hole. Stones were laid on the hole's bottom, then a layer of wood and then the ore. The wood was ignited, melting the ore, and the heavy molten metal flowed through the stones into the tunnel and was deposited on the surface of the slope.[15]

The above method was simple and inexpensive, but very wasteful. By the mid-thirties improved furnaces of brick and stone were in operation. These were usually built in a ravine and over a stream if possible. Of course the nearer the diggings the better. The water was used to wash the mineral and to turn the water wheel which worked a bellows. The smelting process was still simple and relatively cheap. The ore was broken into fine particles and thrown on a large slanting hearth filled with charcoal and wood. Large amounts of wood were needed for the operation and this resulted in the denudation of the hillsides referred to in the quotations above. When action by the water powered bellows on the burning wood produced sufficiently intense heat, the melted lead ran down the hearth into a heated reservoir. From the reservoir the metal was ladled into cast iron molds. The product was a pig, or plat, of lead weighing seventy pounds.

The mode of mineral occurrence, and methods of recovery were no different than those in Illinois or Iowa. There was, however, a

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[14] M. Meeker, "Early History of the Lead Region of Wisconsin," Wisconsin Historical Collection, VI, p. 285.

[15] H. C. Campbell, Wisconsin in Three Centuries (4 vols., New York: Century Historical Company, 1906), II, p. 267.

much larger mineralized zone in Wisconsin and therefore greater quantities of mineral were there awaiting the miners. The size of the mineralized areas of the three states was mapped with relative accuracy by Owen in 1839.[16] That the lead ores were available in large quantities in Wisconsin was proven by the amount of production of the mineral in the early days. This zoomed from 150 tons of metallic lead in 1823 to 5,957 tons in 1829 and reached a peak of 24,328 tons in 1845.

Demand for lead.--Not only was lead plentiful and easy to recover, but fortunately there was an expanding market for it. The practice of painting frame buildings had become common in the United States in the early 1800's. As a result, the paint industry grew rapidly, requiring increasing quantities of lead, a necessary raw material. At the same time, the mineral was also in demand for the making of shot, pipes, sheeting, printer's type and many other articles. An indication of the market for this metal in the United States was the fact that nearly eight million pounds were imported in 1816.[17] It was not long before paint made from Wisconsin lead (often manufactured in Wisconsin) was helping to push the frontier westward. The economic boom in southwest Wisconsin was on.

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[16] D. D. Owen, Report of a Geological Exploration of Part of Iowa, Wisconsin, and Illinois . . . 1839, U. S. Congress, House Executive Document No. 234, 26th Congress, 1st Session, 1840.

[17] J. Schafer, The Wisconsin Lead Region (Madison: Wisconsin State Historical Society, 1932), p. 10.

Lead mining and the early settlement pattern

The story of the spread of mining in southwest Wisconsin is the story of the region's early settlement. After the initial mineral finds were made, people poured into the area by Concord coaches, lumber wagons, ox carts, horse caravans, keel boats, and barges, all hoping to strike it rich. The places occupied first were naturally close to the immigration center for the entire region - Galena. Thus the earliest Wisconsin settlements were at Hardscrabble (later called Hazel Green) and New Diggings (frequently spelled and pronounced New Diggins); both were established in 1824 (Map 2). As more people came seeking easy wealth the frontiers of the Lead Region were pushed east and north. Rich ores were discovered in the vicinity of present-day Shullsburg, Platteville, Mineral Point and Dodgeville, and soon village sites were staked out at these places.

The correlated patterns of lead discovery and town development continued until the outermost frontiers of the Lead District had been reached in 1829. Even after 1829, within these boundaries, new diggings continued to be discovered, resulting in the founding of even more towns. The Fairplay diggings, for example, were first struck in June, 1841, and the news of their discovery made for great excitement in the region, several hundred miners flocked to the place, and a village grew up almost in a day.[18]

Many of the centers prospered for a time and some continued to grow, even after lead mining declined, because they were able to diversify their economic base. In fact, certain of the early mining communities rank today as the area's leading cities, the most notable example being

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[18] Hall and Whitney, op. cit., p. 259.

Platteville. Other settlements were not so fortunate. They gradually lost population and importance as mining became less significant and some disappeared entirely.

The settlement pattern during the lead mining period was one of numerous dispersed hamlets, villages, and towns with little rural habitation between them. Although no data on population distribution for the early stages of development exist, the accuracy of the above statement is certified by the pattern shown on Chandler's map and by contemporary descriptions such as, "Proceeding across a fine rolling prairie, beautiful as a garden, though almost in a state of nature, with at rare intervals a small agricultural improvement, or a hamlet of miners huts. . . ."[19]

This dispersed pattern of occupance was not one of even distribution; rather, there were clusters of settlements in some areas and virtually none in others. Settlement character was due in large part to the mode of occurrence of the lead-bearing ores:

> The arrangement or concentration, of the lead-bearing crevices is in districts of limited extent; so that numerous sub-districts or mining centers are formed within the area of the Lead Region, each in a measure isolated from the others, and frequently separated from them by wide intervals of almost or quite barren ground.[20]

The Platteville diggings, for example, were separated into three sub-districts, which at one time included thirty-three different ranges producing mineral. The overall importance of the mining settlements to the general pattern of population distribution in southwest Wisconsin during the Lead Era becomes strikingly apparent

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[19]S. M. Palmer, "Western Wisconsin in 1836," Wisconsin Historical Collections, VI (1908), p. 304.

[20]Hall and Whitney, op. cit., p. 376.

when comparing the population distribution map of 1839 with the map of the mining operations in the same year (Maps 3 and 4).

The growth of population between 1820 and 1850 was caused largely by the arrival of would-be miners. The number was such as to enable the district to become, for a time, the most densely settled in the Territory. Chandler, on the margin of his map, stated that in three years the estimated population of the Lead Region as a whole (including northwestern Illinois) increased as follows: 1825 - 200, 1826 - 1,000, 1827 - 4,000, and 1828 - 10,000.

The rapid expansion of the mining population had important political ramifications. By 1829 the settlements had become so numerous in the Lead Region that it became necessary to organize the territory south of the Wisconsin River separately. It was detached from Crawford County and organized as Iowa County. By 1836 settlement had so increased that it was deemed adviseable to divide Iowa County into two parts. The eastern section retained the former name, while the western one became Grant County. A dozen years later, in 1848, Iowa County was divided again into Iowa and Lafayette counties. Indeed, "the lead rush of the 1820's and 1830's brought enough people, industry and political leadership to make the granting of territorial status inevitable in 1836."[21] At that time the two counties of the Lead Region, Grant and Iowa, had a full 25% of Wisconsin Territory's inhabitants and was far more densely occupied than the Milwaukee area, which was also being settled.[22]

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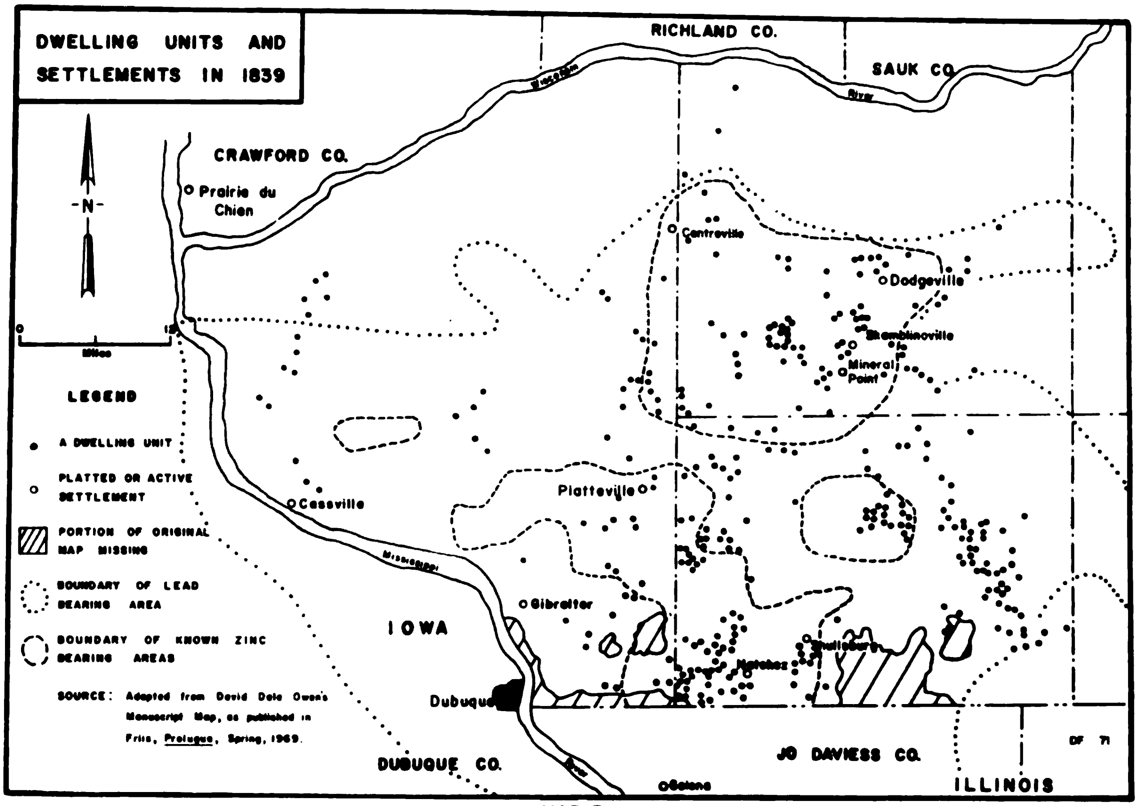
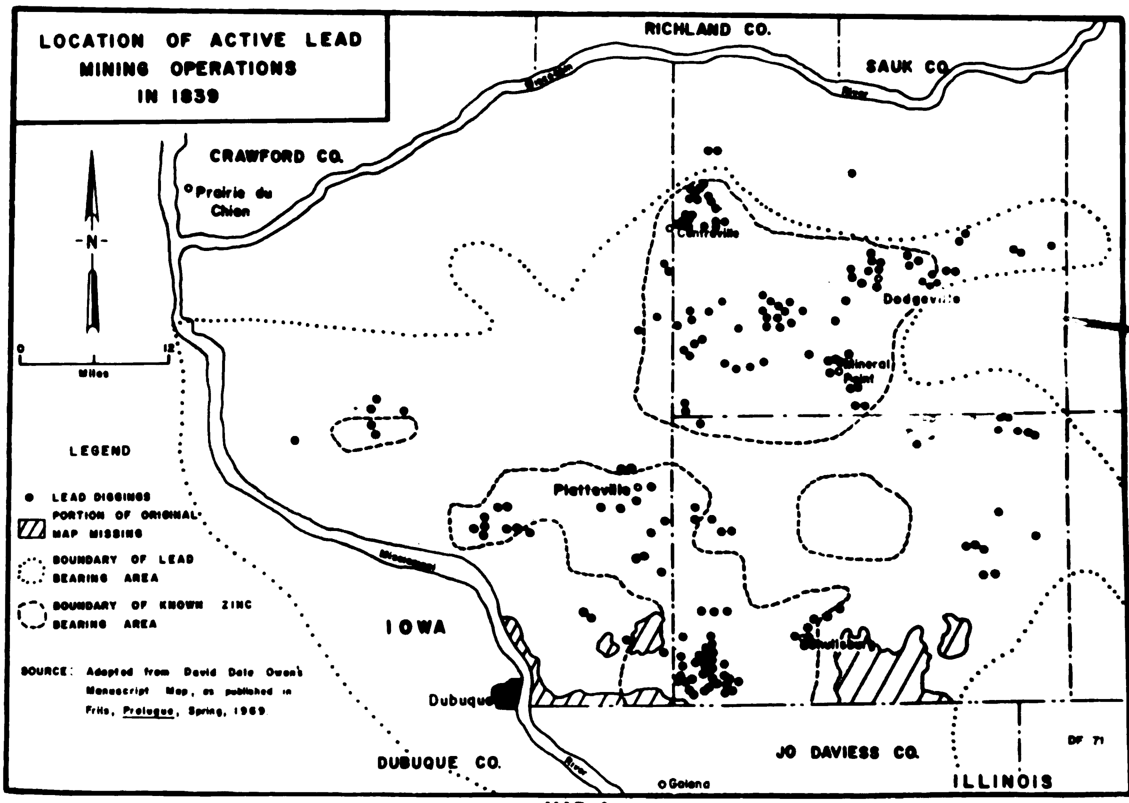
[21]H. R. Austin, op. cit., p. 81.

[22]G. H. Smith, "The Settlement and Distribution of Population in Wisconsin," Wisconsin Academy of Science, Art and Letters Transactions, XXIV (1929), p. 66.


DWELLING UNITS AND SETTLEMENTS IN 1839
RICHLAND CO.
SAUK CO.
CRAWFORD CO.
Prairie du Chien
-N-
0
12
Miles
LEGEND
A DWELLING UNIT
PLATTED OR ACTIVE SETTLEMENT
PORTION OF ORIGINAL MAP MISSING
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREAS
SOURCE: Adapted from David Dale Owen's Manuscript Map, as published in Fritz, Prologue, Spring, 1969.
Centreville
Dodgeville
Mineral Point
Platteville
Cassville
Gibraltar
IOWA
Dubuque
Natchez
Shullsburg
DUBUQUE CO.
JO DAVIESS CO.
Galena
ILLINOIS
DF 71
Mississippi
River

MAP-3


LOCATION OF ACTIVE LEAD MINING OPERATIONS IN 1839
RICHLAND CO.
SAUK CO.
CRAWFORD CO.
Prairie du Chien
-N-
0
12
Miles
LEGEND
LEAD DIGGINGS
PORTION OF ORIGINAL MAP MISSING
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREA
SOURCE: Adapted from David Dale Owen's Manuscript Map, as published in Fritz, Prologue, Spring, 1969
Centreville
Mineral Point
Platteville
IOWA
Dubuque
Shullsburg
DUBUQUE CO.
JO DAVIESS CO.
Galena
ILLINOIS
DF 71
River

MAP-4

Although the population of the district continued to grow, the period of its dominance of the Territory was soon over. Peopling of the lands along the Lake Michigan shore progressed even more rapidly than in the Tri-County region and by the time of statehood in 1848, the latter region accounted for only 17% of Wisconsin's total population.

The story of the relationship between lead mining and settlement of southwest Wisconsin would not be complete without an indication of the origins of the early settlers themselves. The natural link between the Lead Region and the outside world during the first part of the Lead Era was the Mississippi River. The river not only transported the lead ore, but it also carried in the people who occupied the region. They were mainly from the South. Many of those from southern Illinois arrived in the spring but returned to their homes before winter set in (and thus were called "suckers" after the migratory fish). Others came from farther away - many from the mining region of Missouri, a considerable number from Kentucky and Tennessee, and some even from the distant states of Virginia and North Carolina.

As a result of the southern derivation of the majority of the early settlers, and the ties with the South via the Mississippi River, southwest Wisconsin had a distinctly southern social and intellectual character for many years.[23] Southern newspapers were quoted in the local press, slavery was practiced (some immigrants brought negro slaves with them), southern architectural styles were frequently seen (Figure 4), and the governmental concept of county commissioners (of

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[23]Orin G. Libby, "The Lead Region of Grant, Iowa, and Lafayette Counties in Wisconsin," Wisconsin Academy of Science, Art and Letters Transactions, XIII (1901), p. 191.

Figure 4. Rountree, Platteville, Wisconsin.
This mansion of southern style was built by the founder of Platteville, Major John Rountree of Kentucky, who came to southwest Wisconsin in 1827. It is at present owned by the state and is used as the residence of the president of the Wisconsin State University.

Figure 5. Pendarvis House, Mineral Point, Wisconsin.
The house is a restoration of a typical early Cornish cottage. Numerous similar houses remain in several towns of southwest Wisconsin as visual evidence of the Cornish settlement in the early 1800's.

southern origin) was established rather than that of the township (of New England origin). As the region grew and more migrants came from the east, however, and as the direction of the lead trade shifted away from the South to eastern Wisconsin, the population of southwest Wisconsin began to assimilate the "Yankee" character of the rest of the state.

The mining district was unique, too, in the origin of its major foreign segment of population. While other parts of Wisconsin were gaining migrants mainly from Germany and Scandinavia, the largest number of those coming to the Tri-County area were from Cornwall in England. The first "cousin Jacks" arrived in 1827, but the real flood-tide did not commence until 1830. Between 1830 and 1850 it is estimated that the Cornish accounted for 20% of the Lead Region's population; most were miners, as they had been in their homeland. In all, about 7,000 Cornish came to southwest Wisconsin before 1850, when the stream of migration turned to California. These people were looked upon as hard working, solid, upstanding citizens, and they made a large contribution to the development of the area (Figure 5). [24]

Lead mining and the development of transportation

Soon after the first miners reached southwest Wisconsin, roads were established to link the main settlements. As can be seen on Chandler's map, most of these trended north-south, connecting the mining communities with Galena. There were also at that time (1829) a few routes which connected the Lead Region with other areas beyond its

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[24] Louis A. Copeland, "The Cornish in Southwestern Wisconsin," Wisconsin Historical Collection, XIV (1898), p. 334.

borders, e.g. with Chicago, Green Bay, and the Lake District of Wisconsin (Madison). Most of these latter were, however, little more than trails, and not much attempt was made to improve them. There were numerous steep and treacherous grades; bridges were virtually unknown.

The famed Military Road, connecting Fort Howard (Green Bay) and Fort Crawford (Prairie du Chien), was completed by military personnel in 1835. It extended through the Territory at the northern edge of the mining region. It was, however, oriented east-west and thus of no great value to the lead miners. Still, it did provide a safer journey between the Lake Michigan shore and the mining area than a more direct course between the two areas, because of the Indian threat in the latter case.

The main commercial route of the Lead Region, the Mineral Point - Galena Road, was completed in 1837. It was an improved dirt road but still left much to be desired. It "was deep mud during the spring thaw and rains, and deep dust during dry summer weather."[25] Added to the natural disadvantages, this road, and the others leading to Galena, was made worse by the heavy traffic of the lead wagons:

> The road from Galena by way of Elk Grove and Belmont to Mineral Point, then the great thoroughfare for the transportation of a very large portion of the mineral raised in that region, was cut up and rendered almost impassable by immense trains of heavily laden wagons, drawn in most cases by oxen, numbering from four to twelve in a team. These trains made their way slowly, and with great difficulty to Galena. . . .[26]

The fact that lead production was so profitable in Wisconsin, in spite of the great difficulty and expense of transportation, was

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[25] G. Fiedler, Mineral Point, A History (Mineral Point, Wisconsin: The Mineral Point Historical Society, 1962), p. 72.

[26] S. M. Palmer, op. cit., p. 297.

due largely to the low cost of the mining operation.

In the beginning of the lead period the metal went to eastern markets almost exclusively by way of Galena and the Mississippi River. Physical geography played a large role in determining this early route. The Mississippi River provided a natural and relatively easy outlet for the product, especially since land travel was difficult and expensive. Not only was the river important to the lead miners, but the lead trade in turn was important to the steamboat companies and the river cities.

> For a score of years lead cargoes surpassed all others when measured by the receipts of steamboat captains. . . . During the period from 1823 to 1848 approximately 472,000,000 pounds of . . . lead had been mined and shipped down the Mississippi River by steamboat.[27]

Later in the Lead Era another route for shipping the metal came into being and the river was ignored. This was overland to Milwaukee and then by boat via the Great Lakes and Erie Canal to eastern markets. Partially responsible for this change in direction was the natural disadvantage of the rapids in the Mississippi River at Rock Island and near the mouth of the Des Moines River. They appeared during the summer low water and rendered transportation in that period costly in terms of money and time. This, together with the fact that in 1849 New York State reduced Erie Canal tolls on pig and bar lead, resulted in the Milwaukee - Great Lakes route being 25% cheaper than shipping by way of New Orleans. In addition, the smelters received payment for their product more quickly, and the settlers got supplies

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[27] W. S. Petersen, "Captains and Cargoes of Early Mississippi Steamboats," Wisconsin Magazine of History, XII (1929), p. 230.

more cheaply from Milwaukee than from New Orleans and St. Louis.[28]

This shift in orientation of the lead trade affected two outside areas as well - south central Wisconsin and the eastern seaboard markets. The filling up of the lands in south central Wisconsin was aided in great measure by the trade between the Lead Region and Milwaukee:

> The initiatory impulse given to the settlement of this central region of Southern Wisconsin by the early lead and shot trade was of the utmost importance. . . . Without such a path as was traced out for them by the teamster . . . the emigrants of 1840-50 might have been delayed a decade in penetrating to these regions. . . .[29]

Until 1840 the manufacturing of white lead was concentrated in New York and Philadelphia. In that year numerous plants were constructed at Buffalo to make use of the newly arriving lead metal from the Lead Region, which was destined for the east coast via the Erie Canal. By intercepting the shipment of lead at the point of transfer between Lake Erie and the Erie Canal, the Buffalo producers gained a distinct locational advantage over the seaboard plants.[30]

Thus, the relationship between mining and trade and transportation played a significant role in the pattern of economic and social development of the region being studied. Many of the early mining roads later developed into main highways. The shift of trade from the south to the east had important social and cultural implications for southwest Wisconsin as previously noted.

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[28] H. C. Campbell, op. cit., pp. 273-4.

[29] O. G. Libby, "Significance of the Early Lead and Shot Trade in Early Wisconsin History," Wisconsin Historical Collections, XIII (1895), pp. 333-334.

[30] Schafer, op. cit., p. 10.

Lead mining and agriculture

Although southwest Wisconsin first developed as a lead mining region, part of the success in mining was due to the agricultural possibilities present. Many incoming migrants were surprised and greatly encouraged to find the opportunity to raise food, and from the beginning established farms as well as mines. Chandler's map shows several farms (e.g. Charles Farm, Hardy's Farm). These were probably large enterprises for the time and thus worthy of special note. Undoubtedly there were many others too, for the mining region provided a good market for farm produce. Up to the point where the miners' needs were satisfied, agriculture was in a flourishing condition.

The importance of farming to the mining economy is illustrated by the years 1827-29 when the price of lead dropped from $4.50 to $2.00 per hundred. In the Lead Region the miners could afford to recover mineral at a narrower margin than elsewhere due in large part to the production of their own food supplies. Thus, lead production did not fall off in southwest Wisconsin when metal prices dropped. In Missouri, on the other hand, where mining costs were higher because of costly importation of food, lead production declined during this period.[31]

Southwest Wisconsin possessed numerous physical attributes attractive to farming. A relatively long, hot and well-watered growing season, the abundance of broad, rolling to flat uplands, and the many springs, all contributed to its success. It was, however, primarily the fertile, deep silt loam soils of the uplands that gave the region such a fine agricultural character.

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[31] *Ibid.*, p. 42.

In addition to providing necessary items in the life of every settler, agriculture was strongly related to mining in another way. Many persons in the Lead Region pursued both occupations - sometimes exchanging one for the other on a seasonal basis, and at other times pursuing one actively until profits became scarce and then reverting to the other.

A contemporary observer summed up the main relationship of mining and agriculture in the Lead Region during the pre-zinc era when he wrote:

> This mining region possesses one peculiar advantage over others, in the harmony existing between mining and agricultural interests. The farmer raises grain and vegetables which find a ready home market; while during winter he exchanges the labors of the fields for those of the mine on his own land, thus realizing two crops - one on, the other below the ground - every year; one of which is sure to bring a fair price in cash.[32]

Although farming did flourish in the early days, it was definitely subordinate to mining as an economic activity. This was in large part due to the negative attitude of the government of the United States toward agriculture in the region and the fact that private ownership of land was generally not possible until after 1834 and not until after 1846 if there was mineral on it.

The federal policies concerning land use, as provided by law in 1825, allowed mining claims of 300 square yards, versus one fourth of an acre for farming purposes. Permission to farm had to be obtained from the sub-agent of the District Superintendant (an officer in the United States Army Ordinance Division), and it was granted only if cultivation did not interfere with mining. The idea was to subordinate

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[32] T. S. Allen (comp.), Directory of the City of Mineral Point (Mineral Point, Wisconsin: Bliss and Sons, 1859), p. 12.

agriculture to mining, and it was fairly successful. The impossibility of gaining title to land discouraged many from farming, but some became squatters on government land and continued to produce crops as long as prices remained high.

A significant turning point in the development of agriculture was the land survey of the early 1830's and the subsequent inauguration of sale of non-mineral lands in 1834. From that time on farmers outnumbered miners among the new settlers coming into the district.

Schafer's statistics for 1840 indicate that a mixed crop-livestock agriculture prevailed.[33] Corn was the most important crop, a reported 177,000 bushels being harvested that year. It was used to feed the large number of hogs (16,263) and as a food for humans, mainly in the form of corn pone. The hogs were lean and ranged the land at will during the summer. They supplied most of the meat for the Lead Region. Cattle were also numerous but the 8,764 head were mainly dairy animals (dairy products were valued at $10,634) and work oxen. Relatively few sheep were raised. Oats were grown to feed the 2,113 horses which were important work animals for both farmers and miners. Among the other crops, wheat (24,000 bushels) was second in importance to corn; it was ground into flour. Buckwheat was also raised, but only in small quantities. An indication of the significance of agriculture in the later stages of the Lead Era is the fact that as early as 1840 there were as many farmers as miners in southwest Wisconsin.

During the last two decades of the Lead Era, agriculture continued to expand. Crop production and livestock numbers were large

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[33] Schafer, op. cit., p. 134.

and compared favorably with the rest of the State. Thus agriculture had advanced gradually, until by the end of the Lead Era it was a well established, prosperous and fully recognized major economic activity - just as important, if not more so than lead mining.

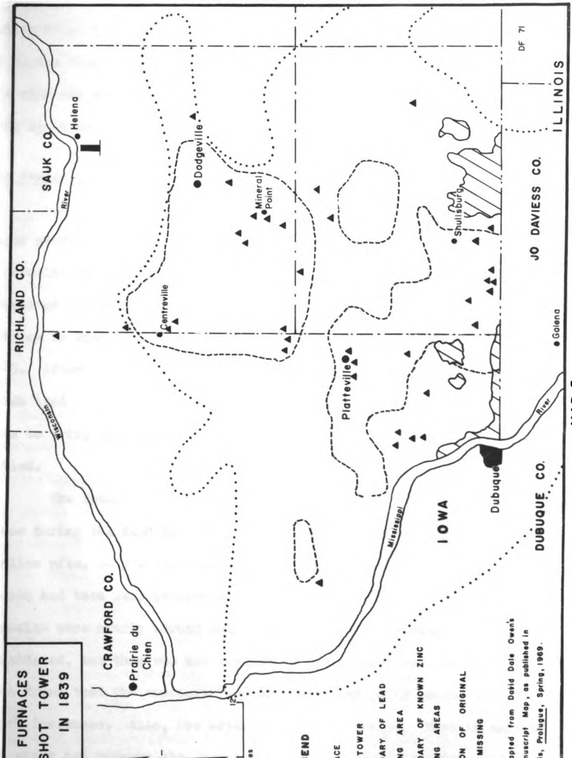
Lead mining and manufacturing

Few manufacturing establishments were developed during the Lead Era, and those that were had a direct relationship to the primary economic activities of mining and agriculture. Grist mills and saw mills were the two most common types of non-mineral industries of the area. By far the most important processing business, however, was the lead smelter (Map 5). Smelters were present in large numbers during the entire Lead Era; many continued operation into the late 1800's. In the early 1840's, Iowa County had four grist mills, seven saw mills, and thirty smelting furnaces;[34] Grant County had four grist mills, twelve saw mills, and twenty furnaces.[35]

One manufacturing activity is worthy of special note because of its direct relation to mining of lead. This was the making of ammunition at Helena, Wisconsin (Map 5). The industry was established when it early became apparent to several residents of the region that profits could be greater if a manufactured good rather than a semi-processed one were shipped from the district. Consequently, in 1830 a company was organized to build a shot tower in southwest Wisconsin. The site chosen was in Iowa County on the south bluff of the Wisconsin River, near the village

[34] John Gregory, Southwest Wisconsin: A History of Old Crawford County (Chicago: S. J. Clarke, 1932), p. 66.

[35] J. A. Wilgus, "The Century Old Lead Region," Wisconsin Magazine of History, XI (1927), pp. 320-7.


LEAD FURNACES
& SHOT TOWER
IN 1839
CRAWFORD CO.
RICHLAND CO.
SAUK CO.
Helena
Wisconsin
River
Prairie du Chien
Centreville
Dodgeville
Mineral Point
Platteville
Shullsburg
Galena
Dubuque
Mississippi
River
IOWA
ILLINOIS
JO DAVIESS CO.
DUBUQUE CO.
N
0
12
Miles
LEGEND
FURNACE
SHOT TOWER
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREAS
PORTION OF ORIGINAL MAP MISSING
SOURCE: Adapted from David Dale Owen's Manuscript Map, as published in Friis, Prologue, Spring, 1969.
DF 71

MAP-5

of Helena. The company secured lead pigs from the nearby furnaces, melted them, and then dropped the molten metal into the tower where it became round and cooled as it fell to the bottom. After sorting, the shot was shipped either by water on the Wisconsin River or overland by wagon. Production continued for over thirty years.[36]

The demise of King Lead

During the 1840's the Upper Mississippi Lead District was the major producer of lead in the United States. The Tri-County area of Wisconsin, the largest and most important part of the District, alone accounted for nearly one half of the national total in 1840.[37] Production in Wisconsin continued to increase until a peak was reached in 1845. After 1847, however, a relatively sharp decline set in from which lead mining was never to recover. Although many attempts were made to bring the industry back to a large prosperous scale, they all failed.

The reasons for the decline were numerous. The mining that took place during the Lead Era was characterized by surface diggings, or shallow pits, only a few tens of feet deep. By the late 1840's the region had been well prospected for shallow lead ore and the existing deposits were nearly worked out. The possibility of deeper mining was considered, but this was not engaged in for several reasons. It had been found that the concentration of galena generally became less as depth increased. Also, the water problem was severe. Work in many of the mines had reached the ground water level but was carried no deeper

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[36] W. A. Titus, "The Helena Shot Tower," Wisconsin Magazine of History, XI (1927), pp. 320-7.

[37] Schafer, op. cit., p. 37.

since the miners did not have the necessary pumps and other equipment. Because mining was usually done by individuals or small groups of men, money was not available in sufficiently large amounts to enable purchase of the necessary machinery. Finally, with an apparently bleak future facing them in the Wisconsin diggings, many of the miners left the Lead Region in 1849 and succeeding years in search of wealth in the newly discovered gold fields of California. This out-migration marked the end of the Lead Era.

Although there was a rapid and continuous decline of the lead industry, a similar trend did not envelope the region's economy as a whole. Such an overall decay might have been expected, for it has occurred in a number of similar situations: the mining areas of northern Michigan (iron ore and copper), northern Minnesota (iron ore), and northeast Pennsylvania (anthracite coal). This did not happen in southwest Wisconsin, however, because the people turned wholeheartedly to developing the area's rich agricultural potential. They were successful in expanding agriculture to take up the slack in the economy created by the decline in lead production.

Thus, by the middle of the nineteenth century, farming was firmly entrenched as southwest Wisconsin's leading economic activity. Mining here would have undoubtedly passed entirely out of the picture, and the region's subsequent fame and development would have been based wholly on its agricultural production and the educational institutions which were later to become significant, had it not been for the establishment of the zinc mining industry in 1860.

Zinc in Wisconsin Before 1860

Production of zinc in Wisconsin did not begin until 1860, but this was not because there was no knowledge of its occurrence. The existence of zinc ore was first mentioned in Owen's survey report.[38] He and his party were assigned by the federal government to survey the mineral lands of Iowa, Wisconsin and Illinois in 1839.

Early knowledge of the deposits

Owen's report not only mentioned the zinc deposits but also explained the origin of the local miner's name of "drybone" for the smithsonite ore:

> This ore, . . . usually occurs in fissures along with the lead. It is chiefly the anhydrous carbonate of zinc of the mineralogist. Though a solid ore, it has an ocherous, earthy aspect, often resembling the cellular substance of bone; hence it is familiarly known among miners by the name of 'dry bones.'[39]

According to Owen's analysis the ore was a true carbonate of zinc, and contained 45% of the pure metal. A second zinc ore was also identified in the report: "Sulphuret of zinc (sometimes called blende, and, by the English miner 'black jack') is also abundant in the Wisconsin mines. It contains from fifty-five to sixty-five percent zinc. . . ."[40]

In 1854, the noted geologist J. D. Whitney published a standard mineral resource treatise of the time in which he said:

> The ores of zinc are plentifully distributed throughout the lead mines of the Mississippi Valley. . . . In Wisconsin the silicate of zinc occurs frequently with

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[38] D. D. Owen, Report of a Geological Exploration of Part of Iowa, Wisconsin and Illinois . . . 1839, U. S. Congress, Senate Document No. 407, 28th Congress, 1st Session, 1844.

[39] Ibid., p. 51.

[40] Ibid.

> galena and is usually called drybone by miners; black jack, or the ferruginous sulphuret is still more common.[41]

It is interesting to note that at this time the ore deposits of Missouri were deemed less significant than those of Wisconsin, for Whitney continues, ". . . the same ores are found in small quantities in the Missouri lead mines."[42]

The first three annual reports of the Wisconsin Geological Survey, those of 1854, 1855, and 1856,[43] were concerned entirely with southwest Wisconsin. Although the main purpose of these surveys was to revive the sagging lead mining industry and to determine the practicality of deep mining, they soundly substantiated the earlier accounts of large zinc deposits in the region. Edward Daniels, the first State geologist, reported that ores of black jack and drybone were abundant, as did also the second State geologist, James Gates Percival, a noted poet and scientist.

The zinc deposits were located close to the cities of Platteville in Grant County, Benton in Lafayette County, and Highland, Mineral Point, Linden, and Dodgeville in Iowa County, according to Owen's statement in 1839. Daniels in his report of 1854, confirms these locations and adds others near Mifflin, Shullsburg and Hazel Green (Map 6).[44]

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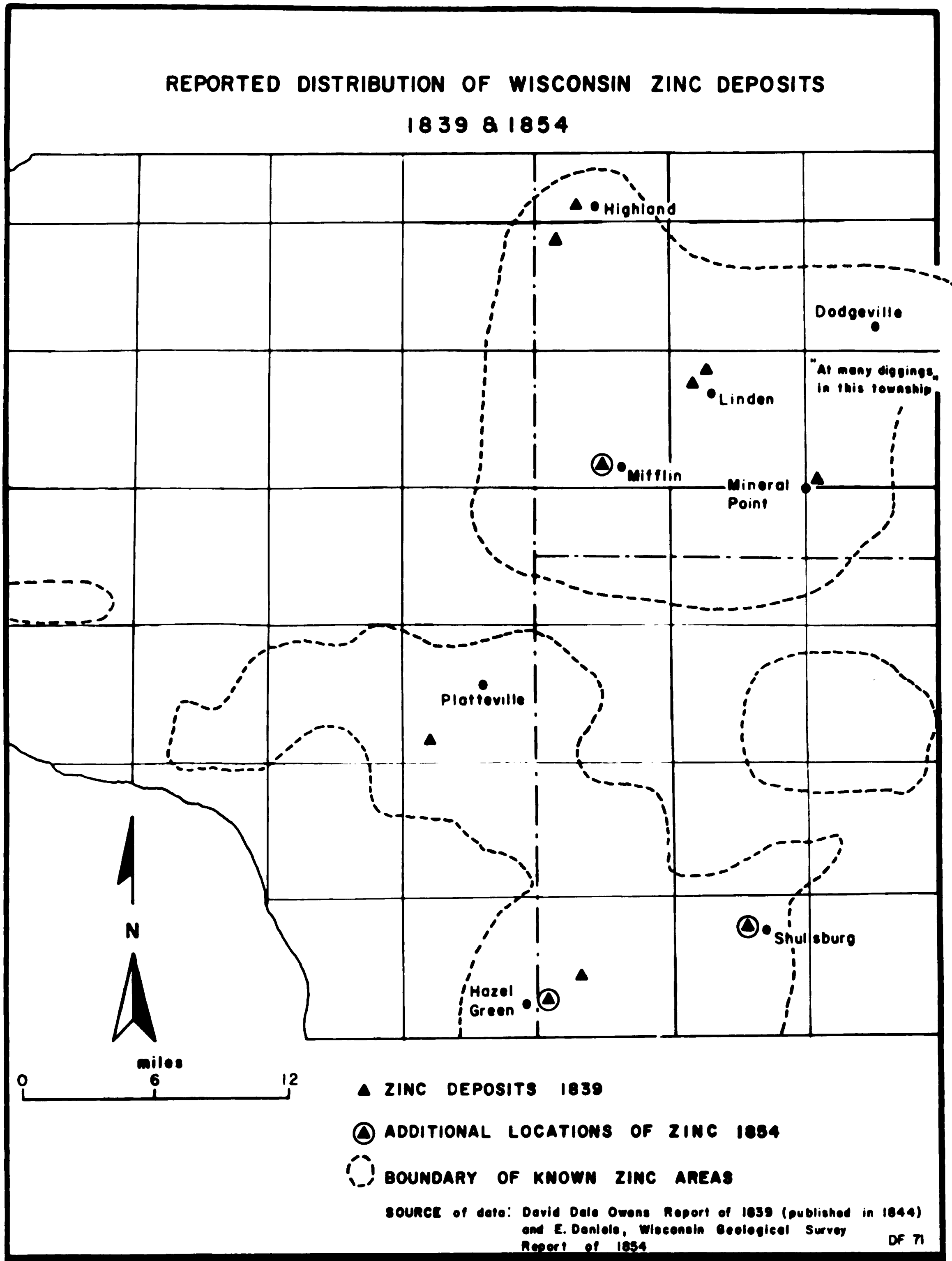
[41] J. D. Whitney, The Metallic Wealth of the United States (Philadelphia: Lippincott, Grambo and Company, 1854), p. 352.

[42] Ibid.

[43] E. Daniels, First Annual Report of Geological Survey of the State of Wisconsin (Madison: David Atwood, 1854).
J. G. Percival, (Second) Annual Report of Geological Survey of the State of Wisconsin (Madison: David Atwood, 1855).
J. G. Percival, (Third) Annual Report of Geological Survey of the State of Wisconsin (Madison: David Atwood, 1856).

[44] Daniels, op. cit., p. 60.


REPORTED DISTRIBUTION OF WISCONSIN ZINC DEPOSITS
1839 & 1854
Highland
Dodgeville
"At many diggings in this township"
Linden
Mifflin
Mineral Point
Platteville
Shullsburg
Hazel Green
N
miles
0
6
12
ZINC DEPOSITS 1839
ADDITIONAL LOCATIONS OF ZINC 1854
BOUNDARY OF KNOWN ZINC AREAS
SOURCE of data: David Dale Owens Report of 1839 (published in 1844) and E. Daniels, Wisconsin Geological Survey Report of 1854
DF 71

MAP-6

Thus, the existence of zinc in southwest Wisconsin was reported as early as 1839, yet no significant production and sale of the mineral took place until two decades later. Indeed, the dry bone and black jack were considered nuisances by the lead miners. It frequently happened that the lead ore in the crevices diminished while that of the zinc gradually increased and entirely replaced the former, "or as the disappointed workman, sometimes with a hearty curse, not very scientifically expresses it, 'the dry bone eats out the mineral' [lead]."[45] Being deemed worthless by the miners, large quantities of zinc were piled in mine openings or drifts below ground, or thrown on rubbish heaps on the surface. Owen, in 1839, found "thousands of tons of zinc ore . . . lying in various locations on the surface rejected as a worthless drug - indeed as a nuisance. . . ."[46] At best the dry bone was used to fill in mud holes in the highway or to pave sections of some of the city streets.

The lag between discovery and use

The lag from discovery in 1839 to commercial production in 1859 was not due to a lack of demand in the United States, for zinc already was being used in large quantities in this country by 1840; but the bulk of the zinc industry's mineral needs was being supplied by the European nations of Germany and Belgium. Sheet zinc was, according to Owen's report, "becoming an article of considerable demand. . . . The chief consumption . . . is in making brass. . . ."[47]

One reason for the lack of production in southwest Wisconsin may have been ignorance on the part of the common miner as to what the mineral

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[45] Owen, op. cit., p. 51.

[46] Ibid.

[47] Ibid.

really was which he called dry bone or jack. Owen refers to this lack of knowledge in his 1839 report: "It is known but to a few of the miners as a zinc ore at all."[48] It must be assumed, however, that as time passed, many miners, scientists, politicians, entrepreneurs, and others in the Lead Region and elsewhere became aware of the existence of the zinc ore, yet did nothing about producing it commercially before 1859. Ignorance of the nature and use of the ore may have been a logical explanation for the lack of production in the 1840's, but with the investigations and reports by the Wisconsin Geological Survey in the 1850's, such a reason can not be accepted as valid for the non-production during that decade.

There are several explanations for the lack of development of the zinc ores before 1859. In the first place, the rock containing zinc was worthless as it came from the mines. To gain value it had to be reduced or smelted, and there were no reduction mills or furnaces anywhere in the midwest until the late 1850's. The absence of such facilities was due in part to inadequate technical knowledge about the smelting process, in part to the scarcity or unwillingness to invest local risk capital, and, even more importantly to a separation of the ore fields from the source of fuel (coal) necessary in large quantities for reduction of the ores. Also, Germany was supplying virtually all the zinc necessary for the growing young nation, at a price with which most capitalists thought domestic producers could not compete.

Still, many writers of this early period believed the Wisconsin zinc deposits to be of great potential value. "Among the productive mineral resources of Iowa and Wisconsin, the present despised zinc ore may claim

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[48] Ibid.

no contemptible rank," said Owen in 1839.[49] Both Daniels and Percival were even more optimistic about the future of the resource. An important reason for this was the increasing use in the United States of zinc as a metal and also of its white oxide as a pigment in paint. By the middle 1850's, zinc white was rapidly replacing white lead as a paint ingrediant not only due to its better quality and cheapness of production,[50] but primarily because of its lack of poisonous qualities.

Daniels, in 1854, sent samples of the Wisconsin carbonate ores to a noted Boston chemist, Dr. A. A. Hayes, Assayer to the State of Massachusetts, for analysis.[51] In his report Dr. Hayes indicated that the ores contained "79-90% zinc oxide, 4/5 of which is pure metal. . . . This large percentage of metal is so favorable combined as to be readily separated by known processes from the ore."[52] Further, Hayes wrote that:

> The ores used abroad for the production of this metal [zinc], are far inferior to these in quality, and they are not extensively distributed. On economical considerations, therefore, these ores have a high value. They offer the advantage of employing a large capital with the certainty of the manufacture being profitable and important. A State promising such mineral deposits must be regarded as rich in resources of a highly important

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[49] *Ibid.*, p. 52.

[50] In contrast to white lead, which was produced from metallic lead, the zinc white could be produced directly from the carbonate ores in furnaces.

[51] It is interesting to note that at this time (1854), the carbonate ores (drybone) were considered to be more valuable than the blende ores (sulphuret of zinc). Daniels, in the *First Annual Report of the Geological Survey of the State of Wisconsin* (p. 60), claimed that the latter ore was very common in southwest Wisconsin, but was much inferior. He explained that he sent only carbonate ores to Dr. Hayes for analysis because, "black jack is better known, and due to its peculiar composition is a less valuable ore, being practically valueless here, from the great expense attending its reduction."

[52] Daniels, *op. cit.*, p. 50.

kind.[53]

Daniels was understandably pleased with Hayes' analysis, and commented that "the results are of the most favorable character, providing the existence of a new source of mineral wealth in the district, second only to its wonderful lead veins(italics mine)."[54] The latter phrase was indicative of the relationship zinc was to have to lead in the minds of many people, but not in reality, in southwest Wisconsin for several decades in the future.

In 1854 there were only two zinc white works in the United States, one in New Jersey, the other in Pennsylvania. Daniels, recognizing the potential importance of zinc carbonate ores in an expanding zinc white industry, suggested that the Wisconsin ores could be made valuable in either of two ways: (1) by transporting the ores to Chicago, where they might either meet the coal needed for reduction, or be shipped further east for processing; (2) by shipping coal to the Lead Region for use in smelting there.[55] In each case considerable expensive overland transport by wagon would have been necessary and this made the suggestions impractical.

Percival's optimism for the development of the Wisconsin zinc ores was more guarded. That he was more cognizant of the transportation factor than Daniels is indicated by his writing: "As soon as easy connexion is formed between the zinc ores in the mineral district, and the coal beds in Illinois by means of railroads it may be reasonably expected that these ores

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[53] Transactions of the Wisconsin Agricultural Society, VI, 1860 (Madison: Smith and Cullaton, 1861), p. 27.

[54] Daniels, op. cit., p. 50.

[55] Ibid., p. 52.

will become objects of importance."[56]

Percival was very forward-looking and actually prophetic in much of his analysis of the zinc situation. Three items may be cited to illustrate his wisdom. He suggested that when the main zinc ore areas of southwest Wisconsin(especially around Mineral Point, and between Shullsburg and Benton) were connected by rail with the coal fields of LaSalle, Illinois, either the coal would move to the ore or vice versa. The latter became a reality in 1860 when Wisconsin ore moved to the new zinc works at LaSalle over the Mineral Point Railroad (opened in 1855) and the Illinois Central Railroad.[57] His opinion that zinc works located where the largest quantities of easily procureable ore existed might well repay investment,[58] was proven accurate by the subsequent establishment and long successful operation of the Mineral Point zinc works. Percival also believed that the jack, since it contained a greater proportion of zinc, would soon be considered as valuable as drybone regardless of the fact that drybone was more easily reduced and was being utilized first.[59] This belief was borne out before the end of the next decade, when the jack was produced in larger quantities than the drybone. Unfortunately Percival did not live to see the soundness of his analysis. He died impoverished and in broken health in 1856. The Second Annual Report of the Wisconsin Geological Survey, which he authored, was published posthumously.

In contrast to the ideas of Owen, Daniels, and Percival, all of

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[56]Percival, op. cit., p. 97.

[57]Ibid.

[58]Percival, op. cit., p. 62.

[59]Percival, op. cit., p. 97.

whom thought high quality zinc ore existed in large quantities and could easily be procured from mine dumps and from underground along with lead,[60] was the thinking of Whitney. In 1854, although acknowledging their occurrence, he took a dim view of the zinc ores of the Mississippi Valley:

> No one acquainted with the manufacture of zinc ores into metal or oxide, would recommend establishment of works for this purpose in the western lead region [southwest Wisconsin], as the business can not be made profitable, against competition of Belgian and Prussian manufactories except under most favorable circumstances of situation and an abundant supply of ore which can be obtained without any considerable mining cost. . . . The zinc deposits of the West do not satisfy these conditions, either as regards quantity or quality of ore, or proximity of fuel.[61]

As late as 1860, there was still considerable doubt and pessimism concerning the development of the zinc resource. That year the "Report of the Wisconsin Agricultural Society's Executive Committee on Natural Resources of Wisconsin" showed some optimism, but still uncertainty as to the development of the zinc ore. The report stated that zinc was to be found in considerable quantity, in the Lead Region, both as sulphuret of zinc blende and as carbonate drybone , but continued:

> Whether these ores can be obtained as an incidental product of the lead diggings, in sufficient quantity to justify the establishment of furnaces and factories is not yet fully determined; though the quality of the ore and the growing value of the white oxide . . . strongly favor the presumption that they may.[62]

Whitney was called upon to examine the Lead Region in detail,

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[60] Owen, in 1839, not only thought there probably was sufficient zinc in the Wisconsin district to supply the entire United States with its requirements for brass production but also enough to export overseas. See Owen, op. cit., p. 52.

[61] Whitney, op. cit., p. 352.

[62] *Transactions of the Wisconsin Agricultural Society, 1860*, op. cit.

in connection with the Wisconsin Geological Survey reorganization which took place in 1856, after the death of Percival. Whitney's later conclusions (1862) regarding possibilities of development of the zinc ores were no brighter than the earlier ones published in his Mineral Wealth of the United States in 1854. In the first place, he found it difficult to determine the amount of ore existing in the region and to estimate the cost of raising it and transporting it to the market, "in case there was a demand for it." (Italics mine.)[63] The latter phrase implies that at the time there was little if any demand for zinc. According to Whitney, the miners believed there were large quantities of ore in the region, but he himself was not satisfied that "the amount of ore required to keep an extensive smelting establishment in operation would be forthcoming for any great length of time, without having to pay a pretty high price for it."[64] In conclusion he said:

> Taking all the circumstances into consideration, and comparing the facility of procuring ore, the cost and quality of coal, the facilities of transportation, the cost of labor, and the value of capital at the West, I am of the opinion that, at present at least, zinc cannot be profitably smelted in the Lead Region.[65]

Recapitulation

Such was the situation regarding Wisconsin zinc before 1860. The ores were known to exist for some twenty years prior to their actual use. Ignorance of the miners about the use of zinc and the smelting of its ores was a reason, but probably the two most important factors in

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[63] James Hall and J. D. Whitney, Report of Geological Survey of the State of Wisconsin, op. cit., p. 370.

[64] Ibid.

[65] Ibid., p. 372.

retarding development were: (1) the lack of adequate and economical transportation for bringing ore and fuel together for smelting and for getting the finished product to market; and (2) the relative absence of risk capital in the midwest for establishing zinc works to process the ore for market. By 1860, several of these drawbacks had been removed, and shortly thereafter the remaining ones would be. Thus, this date can be used to mark the beginning of the Zinc Era in southwest Wisconsin.

CHAPTER II

ESTABLISHMENT AND EVOLUTION OF THE ZINC INDUSTRY

1860 - 1895

Before 1860 zinc was considered worthless by the lead miners of southwest Wisconsin. After 1895 it was well recognized that the future welfare and development of the mines of the district would depend upon the exploitation of zinc rather than lead. During the intervening years lead very grudgingly gave up its position of preeminence among the minerals of the region, although the issue was many times in doubt - at least in the minds of the residents.

The Changing Significance of Lead and Zinc And of "Bone" and "Jack"

Although the peak years of lead production had long since passed, there were many people who firmly believed "King Lead" would make a strong comeback. Official recognition was given to this hope when in 1860 the Executive Committee on Natural Resources of Wisconsin reported:

> It has been the concurrent opinion . . . of all geologists who have examined the district up to the present time that the wealth of the mines has only been partially exhausted and that capital and labor may be profitably employed for years, both in working out numerous diggings unwisely abandoned and in opening new deposits.[1]

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[1] "Report of the Executive Committee on the Natural Resources of Wisconsin," Transactions of the Wisconsin State Agricultural Society, VI, 1860 (Madison: Smith and Culver, 1861), p. 26.

The report was speaking of lead and it went on to mention the fact that considerable interest had been reawakened in lead mining as a result of strikes of several heavy lodes in the late 1850's.

Thus, there was a slight resurgence in lead production, or at least a slacking off of the decline which began in 1848. This was due in large part to three factors: (1) a greatly increased demand for lead as a result of the Civil War; (2) the introduction of new, and occasionally considerable capital by a few large companies; and (3) natural drainage, lowering the water table, made it possible to reopen a number of mines abandoned at a higher water level. Consequently in 1867 the Upper Mississippi Lead District still contained the nation's principal lead mines.[2]

None of these encouragements, however, could permanently check the decadence of the lead industry. At the same time zinc ore was becoming slightly more appreciated. It was reported that in 1869 some of the new companies with their modern methods were:

> . . . making clean work as they go, taking not only the rich paying lead ores as formerly, but also the zinc ores-carbonate (drybone) and sulphuret (black jack), not infrequently found in larger quantities than lead, and which since the establishment of zinc furnaces and zinc white manufactories at Mineral Point and La Salle Illinois have a value of ¼ to ½ that of lead ore.[3]

Optimistic governors in public addresses mentioned the zinc ores as being immense[4] and inexhaustable.[5] Still, Governor James T. Lewis in

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[2]Victor S. Clark, History of Manufactures in the United States, II (Reprinted edition; New York: Peter Smith, 1949), p. 98.

[3]Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868 (Madison: Atwood and Culver, 1869), p. 47.

[4]Grant County Witness (Platteville, Wisconsin), January 17, 1861, p. 2.

[5]Ibid., January 23, 1873, p. 1.

his 1864 message to the Legislature included only the lead, copper, and iron mines as important Wisconsin resources.[6]

Until the 1890's news about lead was much more abundant in local newspapers than about zinc. Articles or notices about a new lead lode being struck, increased mineral (lead) production in a particular mine or town, and fluctuations in the price of lead were regularly published. Even the fact that little or no lead was being mined was deemed newsworthy! By comparison, scant attention was paid to zinc mining in the area newspapers. The History of Lafayette County[7] published in 1881 refers frequently to the lead mines and mining, past and contemporary, but makes not a single reference to zinc ore or zinc mining.

Statistics indicate however, that zinc mining had increased so significantly, that starting in 1871 more zinc than lead ore was produced in southwest Wisconsin (Figure 6). After that, zinc ore output never lost its dominance. Although many residents were oblivious to the increasing significance of zinc, State Geologist T. C. Chamberlin was not. He said in 1882:

> It is convenient to speak of these ore formations simply as lead deposits, but in a critical study of the subject, it is important to observe that we have to deal with a "group" of minerals than with any single ore. Indeed, at present zinc is industrially the more important resource. . . .[8]

Undoubtedly one major reason why lead mining was still considered the preeminent activity long after it should have been, was that the price

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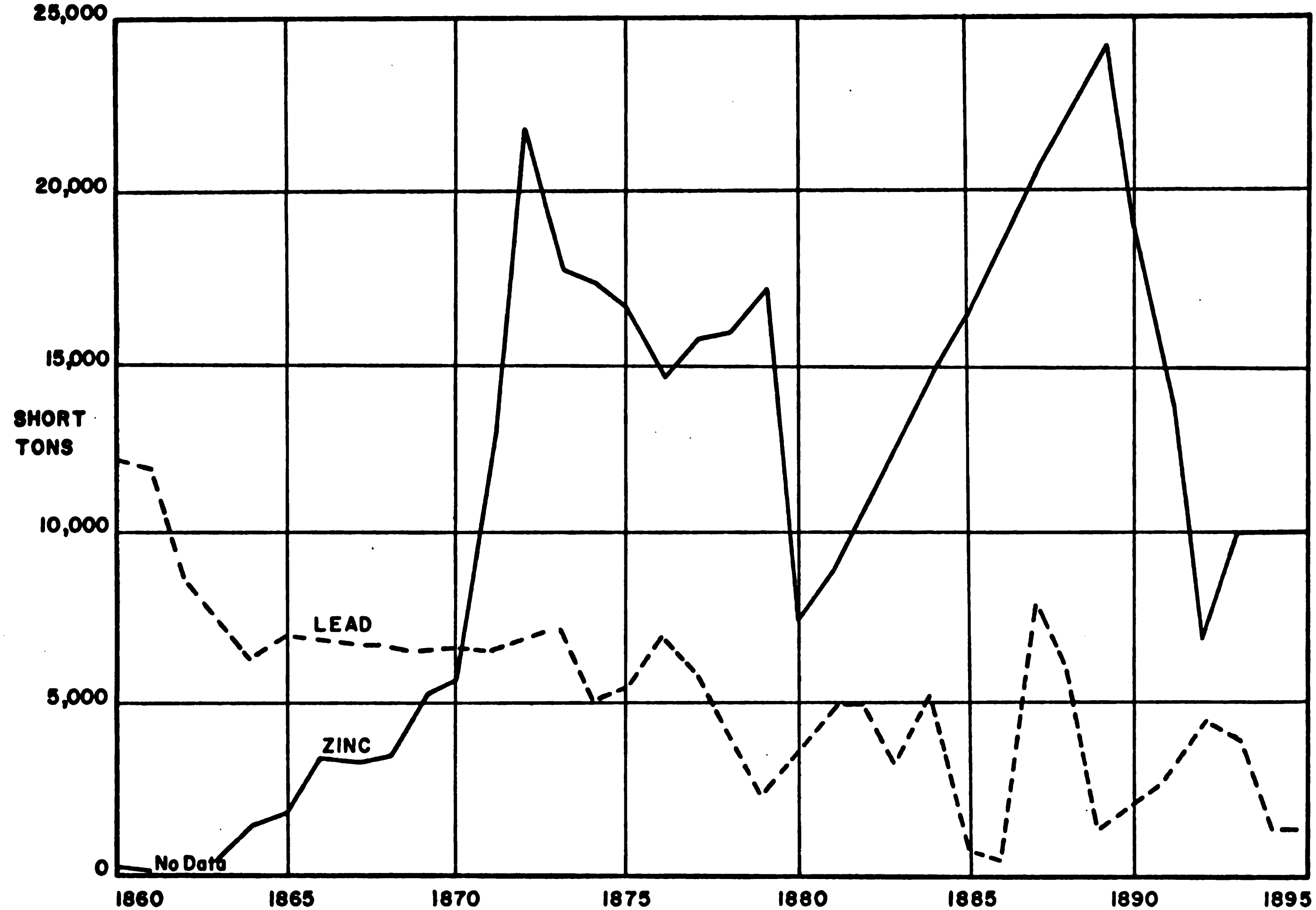
[6] Ibid., January 14, 1864.

[7] History of Lafayette County (Chicago: Western Historical Co., 1881).

[8] T. C. Chamberlin, "Ore Deposits in Southwestern Wisconsin," Geology of Wisconsin, 1873-79, IV (Madison: David Atwood, 1882), p. 377.



Source of data: Chamberlin, Geology of Wisconsin, 1873-1879, Heyl et al., USGS Professional Paper 309, Schubring, A Statistical Study of Lead & Zinc Mining in Wisconsin. DF 71

FIGURE 6. Zinc & Lead Ore Production, 1860-1895, Upper Mississippi Valley Region

for lead ore was considerably higher than that for zinc ore. In the 1860's zinc ore (mainly drybone) was selling for $12-15 per ton in the region;[9] lead metal brought as high as $78 per thousand pounds during Civil War years.[10] Thus, in 1879, although approximately two and one half times more zinc than lead was produced, its value was only $64,562 while that of the lead was $78,525.[11] The price for zinc ore did not fluctuate greatly during the 1860-1890 period. In the 1870's miners were paid $15-20 per ton for drybone and more for blackjack;[12] in the late 1880's drybone was worth between $8-20 and blackjack $16-20 per ton.[13] The value of lead ore, on the other hand, decreased significantly during the three decades. From the high of $78 in the 1860's mentioned above, lead metal prices dropped to $26 per thousand pounds in 1887.[14]

By 1890 the contest of lead versus zinc in the economy of southwest Wisconsin was no longer in doubt. Although lead ore still brought a higher price, the overwhelmingly larger production of zinc ore was more than sufficient to give zinc a greater total value as well.[15] Chamberlin summed up the situation when he wrote:

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[9]Mineral Point Mining Company - Charter and Scheme. (Milwaukee: Starr and Son, 1865), p. 10.

[10]Grant County Witness, June 16, 1864, p. 3.

[11]U. S. Bureau of the Census, Tenth Census of the United States: 1880. Mining Industries, XV, p. 806.

[12]Grant County Witness, July 2, 1874, p. 3.

[13]"In the Lead Region," The Miner and Manufacturer, August 6, 1887, p. 5.

[14]Ibid., and June 9, 1887, p. 6.

[15]U. S. Bureau of the Census, Eleventh Census of the United States: 1890. Mineral Industries of the United States, XIV, shows that the three county total for the value of lead ore production was $64,062, and for zinc was $400,567.

> I incline to the judgement, therefore, that this region, in which the annual zinc product already far surpasses that of lead, and which should rather be called now the zinc district than the lead region, will continue to develop an increasing relative importance in the latter resource [zinc].[16]

Not only did the relative importance of lead and zinc in the region change, but so also did the comparative significance of the two main zinc ores - smithsonite and sphalerite. The smithsonite ore (also known as bone, drybone and carbonate), first discovered and easiest to mine, was utilized before the sphalerite ore (also called blende, blackjack and jack). In fact, until 1865 smithsonite was the only zinc ore utilized. Although blende ore was first successfully smelted in a furnace in or near Mineral Point in 1865,[17] carbonate continued to be considered the most abundant and most valuable of the two.[18] The Superintendent of the Mineral Point Zinc Works sent several specimens of the region's zinc ores to the Paris Universal Exposition in 1867. He commented that drybone was abundant in the vicinity and furnished the principal supply for the spelter (metallic zinc) works at both Mineral Point and La Salle (Illinois), as well as for the zinc white manufactured at Mineral Point.[19]

It was only a short while later, however, that blende became the more important of the two ores. In 1869 blende production surpassed that of carbonate for the first time and, with the exception of three years in the early 1870's (Figure 7), subsequently maintained that lead.

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[16] Chamberlin, IV, op. cit., p. 568.

[17] Mineral Point Mining Company, op. cit., p. 10.

[18] Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868, op. cit., p. 48.

[19] Ibid.

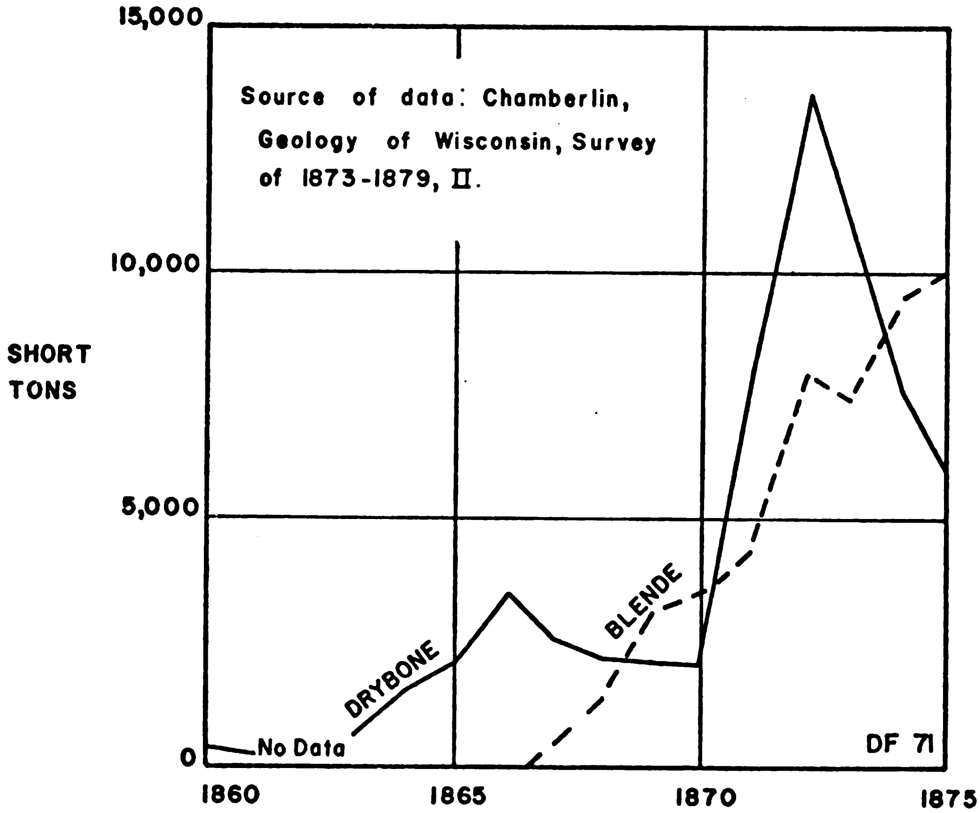

FIGURE 7. Drybone and Blende Production, 1860-1875

Chamberlin wrote in 1882 that blende production greatly exceeded that of carbonate.[20] Blende also continued to be the most valuable of the zinc ores.

The Problems of Capital, Organization and Deep Mining

The zinc industry became firmly established between 1860 and 1895, but not without experiencing many difficulties. One basic

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[20]Moses Strong, "Lead and Zinc Ores," Geology of Wisconsin, 1873-1879, ed. T. C. Chamberlin (Madison: David Atwood, 1883), I, p. 641.

problem to be overcome was the lack of sufficient capital to expand the technology and size of mining endeavors. This in turn was related to the nature of mining organization and the question of the deep location of the mineral deposits.

Characteristics of capital and mining organization

Edward Daniels writing in the First Annual Report of the Geological Survey of Wisconsin suggested that "mining like manufacturing requires for its successful prosecution systematic, comprehensive, and long continued application of labor and capital. Individual mining can be profitable only for short periods."[21]

To be sure, many fortunes had been made through the lead mining organization of an individual, or of a "company" of two or three miner partners, working a claim with little expenditure of capital. In those earlier years the usual procedure was for the owner of the land, or of the mineral rights, after having found what seemed to be a rich lead deposit, to get a small work force of miners together, sink a shaft to the upper-most rich vein, work it until a profit of five, ten, or twenty thousand dollars was realized and then abandon the mine for richer workings elsewhere.[22] Certainly this was haphazard and wasteful, but it was successful and undoubtedly would have continued but for the exhaustion of the ore above the ground water level. When this occurred, in the late 1840's and early 1850's, many miners were forced to change to other activities or to seek jobs in other regions, for they did not have the

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[21]Edward Daniels, First Annual Report of the Geological Survey of Wisconsin (Madison: David Atwood, 1854), p. 43.

[22]Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868, op. cit., p. 47.

capital necessary to drain their diggings through the use of machinery or the excavation of an adit (or level).[23]

Undoubtedly, greater application of capital and better organization would have made the lead mining industry of the 1830's and 1840's even more successful than it was. The fact remains, however, that lead mining in those days was highly profitable even without much capital investment. But by the 1850's capital, or the lack of it, had become a most significant factor in the life or death of the mining industry. It was necessary to have capital in large amounts to get at the "possible" ore deposits below the water level. The Mineral Point Directory of 1859 indicated that "what is needed for their [the mines] development is capital employed as it is in Germany and England where the mines extend from 1,000 to more than 2,000 feet deep."[24] But risk money was scarce in southwest Wisconsin. There was keen competition for capital available between mining promoters, farmers, industrialists, transportation companies, and small businessmen. Also, the uncertainty of mineral deposits existing at greater depths prevented many investors from putting funds into mining operations. This aspect will be elaborated upon later.

Some attempts were made to raise capital through chartered stock companies. Promoters frequently worked in the cities of the region trying to get finances from diverse sources.

> Some charter provisions were designed to foster the public's enthusiasm for investing by making it easier for the small investors to risk their savings. Par values were kept low,

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[23] An adit was a horizontal tunnel, dug into a mine from a nearby hillside, through which the mine could be drained.

[24] T. S. Allen (comp.), Directory of the City of Mineral Point (Mineral Point: Bliss and Sons, 1859), quoted in James A. Lake, Law and the Mineral Wealth of Wisconsin (Madison: University of Wisconsin Press, 1962), p. 88.

> five and ten dollars a share were the rule. The fact that elaborate, engraved stock certificates were received in exchange for small monetary outlays generated public excitement.[25]

Most of the companies failed, however, and to make matters worse many schemes were purely speculative, having been arranged by dishonest promoters. Whitney records this aspect of the mining scene: "Undertakings got up on the plan of the chartered stock companies which are so frequently organized in our cities for working mines, or rather for creating mining stock [italics mine], have invariably proved entirely unsuccessful in the Lead Region. . . ."[26] The risk in a mining activity in general and the particular uncertainty of success at deeper levels, along with the not infrequent spurious stock ventures, contributed to the problem of obtaining capital for the Lead Region.

Fortunately the increased price of lead during the 1860's and the growing demand (resulting in higher prices) for zinc ore resulted in some investors becoming willing to take a chance of further development in southwest Wisconsin. As a consequence, a number of mining and smelting companies obtained charters from the Legislature during the 1860's. Several of these were strong financially, being backed by eastern capital. They purchased territory, according to a writer of that day, and "directed by science, combined with practical skill . . . have begun operations in a manner that augurs well, not only for their success, but also for mining in Wisconsin."[27]

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[25]James A. Lake, Law and the Mineral Wealth of Wisconsin (Madison: University of Wisconsin Press, 1962), p. 88.

[26]James Hall and J. D. Whitney, Report on the Geological Survey of the State of Wisconsin, I (Wisconsin: 1862), p. 418.

[27]Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868, op. cit., p. 47.

These companies gave mining a new lease on life for they were able to do what individual enterprise could not do, namely drain the mines and work below the water table. They dug adits and installed machinery to perform the operation. Sometimes the companies worked the diggings themselves; in other instances the drained land was leased to individual miners on a share basis - taking one fourth to one tenth of all ore raised, depending upon its quality and type of operation.[28]

Perhaps the most famous company of the Civil War period to successfully apply capital and modern (for the time) methods was the one which operated the Champion Mine near New Diggings. The company began running a drainage level in 1862 and finished it in 1865, after an expenditure of $70,000. With the mine free of water, five million pounds of lead ore were removed during a period of four years.

Another company, the Mineral Point Mining Company, was chartered and organized early in 1865 to work an abandoned mine southwest of Mineral Point. They proposed to drain the mine by an adit.[29] This was a successful operation, for in 1867 a handsome dividend on the entire capital stock was paid, and in 1868 the company was reported to be making steady and profitable development of the mine.[30]

The problem of obtaining capital for continued expansion of mining did not end in the 1860's. In fact, it continued to plague the industry for many years. Mrs. H. K. Richmond, a mining promoter, for

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[28] Frederick Merk, Economic History of Wisconsin During the Civil War Decade (Madison: State Historical Society, 1916), p. 112.

[29] Mineral Point Mining Company, op. cit.

[30] Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868, op. cit., p. 47.

example, left Shullsburg in 1888 for Chicago to search for capital.[31] Apparently, either she or others met with success, for later in 1888 two new companies with headquarters in Chicago were incorporated under the laws of Illinois for the purpose of acquiring, developing and operating lead and zinc mines in Wisconsin and elsewhere. The capital stock for each was over one million dollars.[32]

Although the big company type of mining organization, involving the application of large sums of capital and scientific methods, was aimed primarily at the revival and modernization of lead mining, it was most significant in developing the zinc industry. It soon became apparent that relatively small quantities of lead lay below ground water level, but that large deposits of zinc did exist there. Large-scale mining organization not only made knowledge of the presence of this ore possible, but facilitated its exploitation.

Deep mining

In Chapter I it was stated that the basic reason for the decline of lead mining after 1850 was the exhaustion of the shallow deposits then being worked. Mining men and leading citizens of the Lead Region were optimistic, however, and fervently believed (or hoped) that additional rich ores lay at greater depths. Two methods were suggested to ascertain the existence of the deep deposits and both involved the state government.

One was to have the state provide money to sink a test shaft into the Lower Magnesian rock. Implementation was first attempted in

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[31] Grant County Witness, March 7, 1888, p. 3.

[32] Ibid., June 20, 1888, p. 3.

1850, when a bill was presented to the Legislature asking for an appropriation of $30,000. The bill did not pass. Many other similar proposals, memorials, petitions, bills and reports followed, and all suffered the same fate.[33] It is interesting to note that the supporters of the test shaft idea constantly asked for only one shaft. The widespread belief was that if one area within the district contained lead far below the water table, than all parts would. This expensive (and probably inconclusive) method of trying to determine if lead was present at great depths did not answer the question, for it was never undertaken.

The other proposed method to answer the question was to determine the origin of the ores and by so doing infer the depth to which they extended. Two main theories regarding the genesis of the ores were advanced before 1890 by geologists who had studied the Lead Region.[34] One of these was the magmatic hypothesis which supported the existence of deep deposits by supposing that they were formed as a result of hydrothermal deposition originating beneath the bedrock. The second was the meteoric (or lateral secretion) theory, which postulated that the deposits were laid down originally from above by ancient seas, and thus was opposed to the existence of ore bodies very far below the surface. The two theories were hotly debated for some thirty years before 1890,[35] and the views are well recorded in the volumes

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[33]Lake, op. cit., p. 174.

[34]An excellent discussion of the various theories as to the origin of the ores is found in A. V. Heyl et. al. The Geology of the Upper Mississippi Valley Zinc-Lead District, Geological Survey Professional Paper 309 (Washington: U. S. Government Printing Office, 1959), pp. 146-164.

[35]Indeed, the question is still not settled today. The writer had

of the Wisconsin Geological Survey Reports of that period. In fact, it was basically the matter of determining whether there were deep deposits that prompted the Legislature to establish the Survey, with the hope of rejuvenating the lead industry. The views of the geologists that studied the problem between 1860 and 1890 had much to do with the rise and fall of mining activities in the area during that time.

The earliest reference to the origin of the ores was made by Owen in 1847, who concluded that their source was below the bedrock.[36] Whitney, in his Metallic Wealth of the United States (1854), strongly advocated the lateral secretion theory and denied the existence of deep deposits. The first state geologist, Edward Daniels, concerned himself with the question in his 1854 report.[37] He was of the opinion that the lead ores were far from being exhausted and that deep mining would prove profitable, since he held to the magmatic hypothesis. Daniels' belief was supported by the second state geologist, James Gates Percival, in his reports of 1855 and 1856. Although optimistic and encouraging, the reports of Daniels and Percival did not bring the hoped-for recovery of the lead industry. Still, optimism prevailed and the state continued to pay attention to the mines. It was said that "probably no lead mines in the world for quantity of mineral and convenience of working excel those

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the privilege during the summer of 1966 of attending a session at which geologists from all over the world vigorously debated the origin of the ore deposits of the Lead Region. Geologists who are very familiar with the region, however, generally accept a hypothesis similar to the magmatic one.

[36]David D. Owen, Geological Reconnaissance of the Chippewa Land District of Wisconsin, U. S. Congress, Senate, 30th Congress, 1st Session, Sen. ex. doc. 57, 1848, pp. 22-23.

[37]Edward Daniels, op. cit., p. 31.

of Wisconsin. They are one of our chief sources of wealth and as such are entitled to the appreciative consideration of the State."[38]

In 1857 the Wisconsin Legislature appointed, as Commissioners of the Geological Survey, James Hall of Albany, New York, Ezra Carr and Edward Daniels of Wisconsin. Their survey, begun in 1858, was to be concerned with the general geology, mineralogy, and agricultural resources of Wisconsin. In 1859, however, Professor Whitney was additionally contracted to make a careful survey specifically of the Lead Region, including maps. A report was finally published in 1862, combining Hall's earlier work and Whitney's survey of the Lead Region. The latter comprised about three fourths of the entire volume.

The publication of Whitney's work dealt a crushing blow to the advocates of deep mining and the supporters of the magmatic hypothesis. He advanced his lateral secretion theory of origin[39] and in no uncertain terms derided the attempts to prove that there were deposits in the Lower Magnesian rock. He concluded, "We do not intend to come forward . . . as the advocates of deep mining in the Lead Region. . . ."[40] Oddly enough, in spite of Whitney's pessimistic pronouncements, there was shortly thereafter a boom period in the lead industry. This was not due to increased production, however, but rather to a rise in lead prices as a result of Civil War demands.

After the war ended and profits fell, aid was again sought from the legislature. A legislative committee on mining and smelting was

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[38]"Report of the Executive Committee on the Natural Resources of Wisconsin," op. cit., p. 26.

[39]Hall and Whitney, op. cit., pp. 388-402.

[40]Ibid., p. 407.

appointed and requested to "inquire if any and what legislation may be necessary to develop the lead mines. . . ."[41] The committee looked upon the development of the lead mines as of the greatest importance in the diversification of the State's economy. More important, as far as this study is concerned, the report called attention to the fact that although these mines were known generally only for their yield of lead, they were also significant in zinc production. It was suggested by the committee that a commissioner of the lead district be appointed, who should proceed in re-studying the lead mining possibilities.[42] This was undoubtedly an outcome of

> the strong desire on the part of large numbers of intelligent people of the lead district for a more careful and full examination of the reasons which induced Professor Whitney of the late Geological Commission to discourage the hope of making deep mining successful.[43]

One outcome was the appointment of John Murrish as Commissioner. He published two reports (1871 and 1873) and although much criticized for his work by district residents, he did engender more optimism for mining, since he supported the magmatic hypothesis.

In 1871 mining production began to increase significantly. This was not due to an expansion in lead mining, nor to "deep mining" in the strict sense of the term. Rather, it was because of the great growth in zinc production. One major reason for the resurgence in mining was a natural lowering of the water table. Supposedly, this had been taking place for many years and was the result of removal of timber and increased

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[41] Grant County Witness, March 18, 1870, p. 1.

[42] Ibid.

[43] Transactions of the Wisconsin State Agricultural Society, IX, 1870 (Madison: Atwood and Culver, 1871), p. 51.

cultivation in the region.[44] By 1871 many diggings, originally abandoned due to high water, were dry enough to be re-opened and worked profitably without investing in costly pumps. Thus the ores being utilized were deeper than in the past but were still extracted by the same old methods. This was not deep mining. Work continued in most diggings only until the new water level was reached. As a consequence, decline in production again set in during the late 1870's.

Meanwhile, on March 19, 1873, the Wisconsin Legislature approved an act providing for a new and complete geological survey of the state. (The earlier law authorizing such a survey had been repealed by the 1863 Legislature.) The noted Wisconsin scientist Increase A. Lapham was the first director of the new survey and served in that capacity until February, 1875. He was replaced by O. W. Wright, who in turn was succeeded by Thomas C. Chamberlin in February, 1876. Chamberlin served as chief geologist until the survey was completed in 1882. The resulting reports were published in four volumes and contain a wealth of scientific and historical information about Wisconsin; much deals specifically with the Lead Region.

One of the principal objectives was to make ". . . a careful topographical survey of the lead region for purposes of ascertaining as far as possible, the amount of denudation and extent of mining ground in each locality. . . ."[45] Moses Strong, a young geologist and son of a noted Mineral Point financier, was one of the four chief assistants

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[44]Moses Strong, "Geology and Topography of the Lead Region," Geology of Wisconsin, 1873-1879, II, ed. T. C. Chamberlin (Madison: David Atwood, 1877), pp. 657-658.

[45]I. A. Lapham, "Report of Progress and Results for the Year 1873," Geology of Wisconsin, 1873-1879, ed. T. C. Chamberlin (Madison: David Atwood, 1877), p. 6.

on the survey; he was given the task of studying the Lead Region. After completing much of his initial assignment, he was accidentally drowned while working in northern Wisconsin. His reports on the Lead Region, as well as those of Chamberlin, in Volumes I, II, and IV of the publication mentioned above form valuable records of the mining industry in southwest Wisconsin during the late 1870's and early 1880's.

At first, the new geological survey did little to encourage the mining industry in the Lead Region. Chamberlin was a strong advocate of the meteoric hypothesis of ore origin, and developed the ideas of Whitney in great detail;[46] thus he did not have much hope for deep lead mining. He believed, however, that there was a greater richness of zinc in the lower beds, and about this he spoke optimistically, saying that the region would continue to develop an increasingly important production of zinc.[47]

In spite of the facts that no test shaft was ever sunk and the origin of the ores was never proven beyond a doubt, much significance may be attached to these attempts to solve the question of the existence of deep deposits. In the first place the question prompted considerable study of the region and gave posterity hundreds of pages of valuable reports, maps, and statistical data concerning the area and the mining industry. Second, the reports established the significance of the zinc deposits. Chamberlin's published findings were therefore undoubtedly a major stimulation to zinc mining and helped carry this activity into the boom period which will be described in the next chapter.

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[46]T. C. Chamberlin, "Ore Deposits of Southwestern Wisconsin," Geology of Wisconsin, 1873-1879, IV (Madison: David Atwood, 1882), pp. 522-553.

[47]Ibid., pp. 567-568.

Mining Activity

Prior to the Civil War practically all the zinc ore produced in southwest Wisconsin was obtained from lead mine dumps. As the demands for zinc grew and the spoil heaps had been thoroughly worked over, the miners next turned to the investigation of old shafts for their untouched zinc deposits. Eventually, they began to prospect and mine for zinc itself and did not seek it as an adjunct to lead.

Exploration

The search for ore bodies was very simple. Although churn drills had been in use in mineral exploration for many years before 1871 in other parts of the nation,[48] they were virtually ignored in the Lead Region until after 1890. Knowledge of advanced tools and methods, however, was not lacking. Strong, in the late 1870's, states that "the introduction and use of diamond drills for prospecting would undoubtedly be attended with remunerative results. . . . For discovering and proving the extent of flat sheets there is no instrument which is their equal."[49]

Even though known, however, use of more modern prospecting methods was made difficult, if not impossible by the scarcity of capital and small-scale organization of the mining. Thus, the primary methods of finding zinc ore were those used by the early lead miners. These included: (1) searching for "float" ore of either lead or zinc; (2) looking for minerals such as calcite, barite, and pyrite, in the soil since these normally accompanied the metallic ores; (3) finding

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[48] Arthur B. Parsons, Seventy-five Years of Progress in the Mineral Industry, 1871-1946 (New York: American Institute of Mining and Metallurgical Engineers, 1947), p. 44.

[49] Moses Strong, 1883, I, op. cit., p. 649.

certain yellowish or reddish ocherous clays in the soil or in rock crevices, which served as indicators of the frequence of ore deposits; (4) hunting excessive growths of grass and weeds which often marked the course and direction of mineral bearing crevices (this method became less important as agricultural land use spread); and (5) in the case of some prospectors, at least, relying heavily on surface contours as a guide to mineral deposits.[50]

There was no attempt to determine the extent of an ore body once it was found. Its horizontal and vertical dimensions, and its quality were not defined until actual mining took place. The prevalent attitude was, there is ore here, let us mine it until it is exhausted. Exhaustion might occur after two weeks, two months, or two years, but usually the miners would not know when in advance.

Shaft sinking

After discovering an ore body, the procedure followed in working it was simple and standard for the district. It consisted of sinking a vertical shaft, horizontal drifting, separating the ore from the rock, and bringing it to the surface. The shaft was generally small, shallow, near to other openings, and sunk with no view toward permanence. The close spacing of the shafts was largely a result of the slowness and difficulty of the drifting operation. At first shafts were usually no more than 600 feet apart, but as drifting speed increased they were more widely positioned.[51] The deepest shaft before 1854 was 175 feet, but most ranged between ten and sixty feet.[52] In general, this characteristic

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[50] Ibid., p. 645.

[51] Parsons, op. cit., pp. 52-53.

[52] Daniels, op. cit., pp. 21.

continued until the turn of the century. Very seldom was a shaft sunk deeper than one hundred feet, and usually to a considerably shallower depth. Frequently the shaft served several purposes. Exploration and exploitation were two of these. This being the case, the custom was to sink the shaft on the vein, which often resulted in the opening being quite crooked. Another purpose was ventilation. Usually two or more shafts and associated excavations were worked at the same time and were connected for ventilation.[53]

Digging the shaft was done entirely by hand, for it was a difficult process to mechanize. The cost varied considerably from place to place, depending primarily upon the hardness of the rock and the need for cribbing. Cribbing (supporting the shaft sides with wood) was done if the ground was soft. Digging a typical four by six foot shaft cost from five to fifteen dollars per vertical foot.[54] Beginning in 1850, the Cornish miners introduced a very effective but slow hand-drilled method of shaft sinking. This permitted penetration at a rate of about thirty feet per month in fairly hard ground.[55] The shaft would be continued until the main ore body was reached. Not infrequently exploratory drifts would be run off from the shaft whenever indications of ore appeared.

Mining the ore

The usual manner of ore occurence did not, however, necessitate a very complicated system of mining. When the main ore body was reached, its removal began at the base of the shaft and proceeded in all

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[53]Strong, 1883, op. cit., p. 649.

[54]*Ibid.*

[55]Parsons, op. cit., pp. 52-53.

directions through horizontal drifts which followed the deposit sheets as long as they continued to be productive.[56] This system required but little development work before removing the ore. As the vertical distribution of the sheets was seldom very great, there was not usually a need for a series of drifts situated at various levels as was usually true in other mining regions. Whenever the sheet was large enough the miners employed either "direct stopes" (working in the floor), or "reverse stopes" (working in the roof) to obtain the ore.[57] In extending the drifts, care was taken to leave the main ones open between the shaft and the unworked portions of the ore sheet. The drifts varied in size, the average being about six feet high by four feet wide. The cost for excavating one of such dimensions was from $5-30 per linear foot. The cost increased as the drift was lengthened and the material had to be transported a greater distance.[58]

The actual mining consisted of loosening the ore-bearing rock from the working face in the drift and then separating the pay dirt from the waste. This was done by drilling, blasting, and/or pick axe operations. In these aspects of mining the relative backwardness of the Lead Region is well illustrated. For many years nearly all drilling was done by hand with hammer and drill, jumper or auger. Piston drills using compressed air had been utilized in Europe as early as 1861, while the Burleigh, a drill of advanced design, was being used widely in Western United States for tunneling and drifting by the 1870's.[59] Again, it was

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[56]Strong, 1883, op. cit., p. 648.

[57]Ibid.

[58]Ibid., p. 649.

[59]Parsons, op. cit., p. 42.

not because these better drilling techniques were unknown that they were not employed in southwest Wisconsin. Strong suggested, for example, that "the recent inventions in pneumatic, or compressed air drills and in mining explosives such as dynamite and Rend rock, are daily rendering the excavation of levels a much less laborious task."[60] This was in 1877. In 1883 Chamberlin indicated the backwardness in southwest Wisconsin, however, when he said: "The occurrence of ores in flat sheets and openings with wide working faces affords opportunity in many places for advantageous use of steam or pneumatic drilling machines. *They have as yet been introduced in the Lead Region but to a limited extent*." (Italics mine.)[61]

Blasting.--The same was true with blasting powder. Common black powder was the chief agent for blasting in southwest Wisconsin up to 1890. No other explosive was used in metal mining anywhere in the United States until after 1865. In the late 1860's, however, such explosives as nitroglycerin, nitroglycerin-dynamite and ammonia dynamite made their appearance on the American mining scene.[62] But they were slow to be adopted in the Lead Region. Strong, writing in the late 1870's, indicates that:

> In the Lead Region, common blasting powder is the material chiefly relied on, and the introduction of various powerful explosives, discovered in the last quarter century, proceeds with great slowness. Accidents from the use of these are usually quite as rare as from the use of common powder, and considering the great economy of time and expense that attends their use, they ought to be more generally employed.[63]

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[60]Strong, 1877, *op. cit.*, p. 751.

[61]In Strong, 1883, *op. cit.*, p. 649.

[62]Parsons, *op. cit.*, p. 45.

[63]Strong, 1883, *op. cit.*, p. 649.

Nitroglycerin was first used in the area in 1871. Its worth was proven when in September, 1871, three charges of this explosive and one man working six days did the work of fifty charges of common powder and four men working six days at the Fairplay mine.[64] Crawford Mills and Company of Hazel Green, one of the region's largest and most successful mining concerns, built a nitroglycerin factory in 1872.[65] The process of manufacturing was simple, but the cost of transportation was very high due to the nature of the product. Thus, by manufacturing it close to the mines, transportation charges would be greatly reduced. The company also found its use very economical, having spent $60-70 per foot in running a level with common powder, while by using nitroglycerin they reduced the cost to $17 per foot.[66] The factory at Hazel Green produced about 3000 pounds of nitroglycerin between 1872 and 1874.[67] By 1877 use of the new explosive had spread to New Diggings, Galena, Dubuque and other places in the region. It was predicted that if the miner's prejudices against it could be overcome, it would probably become the most important explosive in the area.[68]

Ore removal.--As soon as possible after being broken the ore was removed. This operation included hand loading the ore into wooden cars (or wheelbarrows if the haul was short), which were either pushed by the men or hauled by mules or horses through the drift to the shaft. In the

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[64] Grant County Witness, September 21, 1871, p. 3.

[65] Ibid., April 4, 1872, p. 3.

[66] Ibid.

[67] Strong, 1877, op. cit., p. 705.

[68] Strong, 1877, op. cit., p. 705 and Strong, 1883, op. cit., p. 644.

very early zinc mining period the ore (and waste rock as well) was hoisted in wooden tubs, called kibbles, by a simple hand-powered windlass.[69] Greater mechanization was soon effected by the use of the hoisting gin (also called whim or whippsyderry) which utilized horsepower. One horse, sometimes driven by a boy, would walk around and around in a circle near the shaft. The horse, through a series of connected rods, gears and cranks supplied sufficient power to raise the ore-filled buckets from below.[70] The hoisting gin was often combined with a pump, but these two operations could be separated as it was seldom desirable to carry on both at the same time. Underground in the drift the miners would get rid of as much unproductive rock as possible by filling up the worked-out portions of the opening. Any waste still remaining would be hoisted up the shaft to the surface. The disposal of waste rock underground also served to support the roof or cap. In places where the roof was weak it was necessary to give considerable support to it. Sometimes pillars, containing ore were left for this purpose.[71] Timber, of course, was also used. It was generally obtained from the local area and treated to prevent breakage and rot by bathing it in a hot solution of zinc chloride. Creosoted timber was used on the surface but not underground because of its flammable nature.

Drainage

Mine drainage was a serious problem. To be sure this was one of the major results of the scarcity of capital and lack of adequate

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[69]Strong, 1883, op. cit., p. 648.

[70]Parsons, op. cit., p. 67.

[71]Daniels, op. cit., pp. 37-38.

organization. As mentioned above, before the Civil War mining usually stopped at the water level. Occasionally if a vein was rich enough to follow deeper, a lifting pump worked by horses or oxen might be used to remove the water.

The system of individual mining was also a handicap to adequate mine drainage. Because of the limited size and close spacing of individual claims, one mine often could not be drained adequately without removing water from several nearby mines belonging to different owners. Often the ground below water level remained unworked because one miner did not wish to bear the entire expense of drainage when several others would benefit too.

As late as 1870 the problem of drainage was considered to be a serious one, as indicated by Gregory's statement:

> The mines of southwest Wisconsin are not worked with the same economy as those of the old country, where the operation requires steam power, at an enormous expense, to be employed day and night to unwater them. Here the moment the mine becomes innundated, which is often the case, at a small depth, it is at once abandoned.[72]

As time passed, however, more mines were drained by artificial means of one kind or another. A common method, if the amount of water was not great, was to bail it into a large tub or barrel and hoist it out through the shaft by use of a windlass. To speed the operation, frequently two tubs were used, one of which was lowered and filled while the other was hoisted and emptied.[73] If the amount of water was large and capital was available, a pump was used. In some cases a

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[72]John Gregory, Industrial Resources of Wisconsin (Milwaukee: See-Bote Job Printing, 1870), p. 130.

[73]Strong, 1883, op. cit., p. 643.

horse supplied power to operate the pump. Steam power which was quite costly, was also used most commonly by wealthier companies or individuals. Strong suggested that pump drainage succeeded in drying only comparatively small areas and when the pumps stopped, water immediately returned. Thus he said pumping operations should be carried on only where large ore bodies were known to exist in a relatively small ground area.[74] Generally, these methods of bailing and pumping were looked upon merely as temporary expedients to control the drainage problem.

Some of the larger and wealthier mining companies, however, began employing another type of drainage in the post-Civil War period. This involved digging a tunnel laterally into the deposit and using it not only to drain the mine, but for removing ore and for ventilation as well. This method of constructing levels or adits was looked upon as being quite progressive, it being stated that the adits can "effect complete and economical drainage and ventilation and can draw off the mineral on tramways at a vastly greater advantage than possible under the old hoisting system."[75] Strong also advised miners that the drainage of a mine by the level method was permanent and extensive, and that "judging from the number of levels that have been excavated, and the success which has usually attended them when completed, the system of mining by levels seems to offer the safest field for the employment of capital."[76] Since the amount of capital necessary to excavate a level was quite large, however, this method was slow to become widespread in use, except by the larger companies.

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[74] Strong, 1877, op. cit., p. 751.

[75] Transactions of the Wisconsin State Agricultural Society, VII, 1861-1868, op. cit., p. 47.

[76] Strong, 1877, op. cit., p. 751.

Mention should also be made of one other technique employed to effect mine drainage. A hole would be drilled in the bottom of the mine to reach some of the underlying clay beds. The hole would be placed in a strategic lower elevation in the mine. One hole would be used until it became clogged with mud and then another one would be drilled, the process being repeated as often as necessary. Needless to say, the relative uncertainty and inefficiency of this method resulted in its infrequent use.

Thus, between 1860 and 1895, although the zinc mining industry grew and prospered in southwest Wisconsin, little advance was made in the modernization of mining. This has been indicated above in describing prospecting, shaft sinking, drifting, blasting and drainage techniques. As late as 1890 the mining industry of the state, it was said, "more closely approaches that of primitive conditions than it does in any other part of this country."[77] In 1879, when Wisconsin ranked sixth among the states in zinc ore production and had ninety producing mines, there were only three steam engines and ten pumps or pumping machines being used. Even the application of animal power was uncommon, there being reported that same year only sixteen horses and one mule at work in Wisconsin mines.[78]

Conditions were evidently little better in 1889 for, although no census statistics are available, another source reported that "the amount of machinery employed, excepting by one large company, is small, and the quantity of supplies consumed is very low. . . . The greater part of the product is the direct result of manual labor applied to

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[77] U. S. Bureau of the Census, 1890, op. cit., p. 165.

[78] U. S. Bureau of the Census, 1880, op. cit., p. 806.

small individual operations."[79]

Characteristics of mine labor

In the earliest days of lead mining in southwest Wisconsin there was no differentiation among the workers in the industry. By the time zinc mining was on a solid footing, however, at least two main groups were recognized, i.e., miners and laborers. Miners normally were employed below ground, although not exclusively. In the small companies they would engage in all tasks below ground connected with the mining operation. Labor was more specialized in the larger concerns; miners there were the skilled employees who did the drilling and blasting. The laborers, always in smaller numbers than the miners, were engaged in necessary but unskilled activities such as shoveling, or as in the case of boys, guiding a horse about the whim (horse pump or hoist).

According to the 1880 census, of the 336 persons employed in mining in the Lead Region, 95 worked above ground and 271 below ground. Miners numbered 287, laborers 69 and 10 were listed as administrative force. Of the total, 26 were boys, 12 of whom worked below ground.[80]

Wages ranged from $1.25 to $1.50 per day for both miners and laborers. The workday for a miner was an eight hour shift and for the laborer, a ten hour shift.[81] Frequently the wages reported in state or federal data represented the value of both labor and profit in the mine since many mines were operated by two or three men working as

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[79]U. S. Bureau of the Census, 1890, op. cit., p. 165.

[80]U. S. Bureau of the Census, 1880, op. cit., p. 806.

[81]Strong, 1883, op. cit., p. 643.

partners and doing all the work themselves.[82]

By 1889 the number of persons connected with mining had increased significantly and there was more job specialization. According to the 1890 census, mining employed 25 foremen, 24 mechanics, 598 miners and operators, 488 laborers, and 10 boys. Wages for miners and laborers were little better than in 1879; the daily average ranged from $1.25 to $1.79 with miners receiving the higher pay. Mechanics and foremen fared considerably better, receiving an average from $1.60 to $2.18 per day.[83] According to a notation in the census, "considering all the circumstances, the earnings are very moderate."[84]

An indication of the miners relatively short working period during the year is also shown by census data. In 1889 miners averaged 121 days in Grant County, 136 days in Lafayette County, and 191 days in Iowa County. Laborers worked more days, ranging from an average of 177 in Grant County to 246 in Lafayette County.[85] These data reflect the prevailing nature of mining as a part-time activity in southwest Wisconsin.

Working conditions in the mines were generally poor, but in this respect there was no great difference between mining in Wisconsin and in other parts of the nation. Significant reforms in the United States relative to miners' health, safety and welfare did not take place until years later.

Lighting was bad. It was generally furnished by candles; tallow dips held in place on the miner's hats by balls of clay. Working areas

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[82] U. S. Bureau of the Census, 1880, op. cit., p. 805.

[83] U. S. Bureau of the Census, 1890, op. cit., p. 166.

[84] Ibid., p. 165.

[85] Ibid., p. 166.

were often cramped, ventilation was poor, and most mines were wet. Accidents were not infrequent, but the most common type was not what one would usually expect. The vast majority reported in the Grant County Witness between 1860 and 1890 occurred in the shaft. A miner would fall or slip in the shaft and hit his body or head against its side or plunge to its bottom. Another common occurrence was when material from the top or side of the shaft fell onto a person below. Such accidents were frequent and many were fatal. Two other kinds of mishaps reported in the press were those which might more commonly be associated with mining, i.e., cave-ins and explosions. Underground cave-ins were relatively infrequent. Since this was an obvious danger the workers, especially the skilled ones, were very careful about having a strong roof or else installing support for a weak cap rock. Explosions too were infrequent, but did occur. Occasionally a miner would become careless. Joseph Swinbank, for example, who worked in the Townsend Level near Shullsburg in the late 1880's, was severely injured when a cartridge he was carrying in his bootleg began to burn and exploded before he could get rid of it. The hazardous practice of carrying a cartridge in the boot was common since it would more readily ignite and explode when needed if kept dry.[86]

Fires also took their toll in lives and property, but were infrequent underground. They often occurred on the surface, however, as a result of a boiler explosion or some other cause, sometimes causing property losses of thousands of dollars and forcing the mine into temporary shutdown.

An interesting and perhaps surprising indication of some mining conditions in the 1870's is found in the following work rules posted at

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[86] Grant County Witness, February 23, 1882, p. 3.

the mine entrance of the Williams Diggings near Hazel Green.[87] The mine employed forty men.

(1)Everyone will be ready to go to work at the time his shift goes on, to the minute.
(2)Anyone wishing to stop off a shift will give at least a days notice, and anyone leaving a shift without notice unless on account of sickness, or a reasonable cause, will be considered as leaving the works. No one will be allowed to put a man in his place without consent of one of the proprietors.
(3)All personal or indecent language is strictly prohibited between the hands. Anyone indulging in such will be discharged.
(4)Anyone employed on this work is forbidden to bring whiskey to the diggings.
(5)Every shift will be responsible for all gads, wedges, etc.
(6)One half hour will be allowed for meals.

Mining Districts

Owen and Daniels in their respective reports of 1839 and 1854 indicated that zinc ores were found in or near Platteville, Benton, Highland, Mineral Point, Dodgeville, Linden, Mifflin, Shullsburg, and Hazel Green. Whitney found the most productive zinc districts in 1862 to be Mineral Point, Holyhead (near Dodgeville), the Drybone Diggings near Shullsburg, and the diggings near Franklin (Highland) and Centreville. Maps 7, 8, and 9 show the location of zinc mining in 1877, 1880, and 1882, indicate the continuation of the importance of the above-mentioned areas. Following is a survey of zinc mining activity in the three counties between 1860 and 1895.

Lafayette County

In Lafayette County zinc mining developed very rapidly during the latter stages of the period under study. Between 1880 and 1890 zinc ore production there increased from 422 tons to 7,132 tons. The

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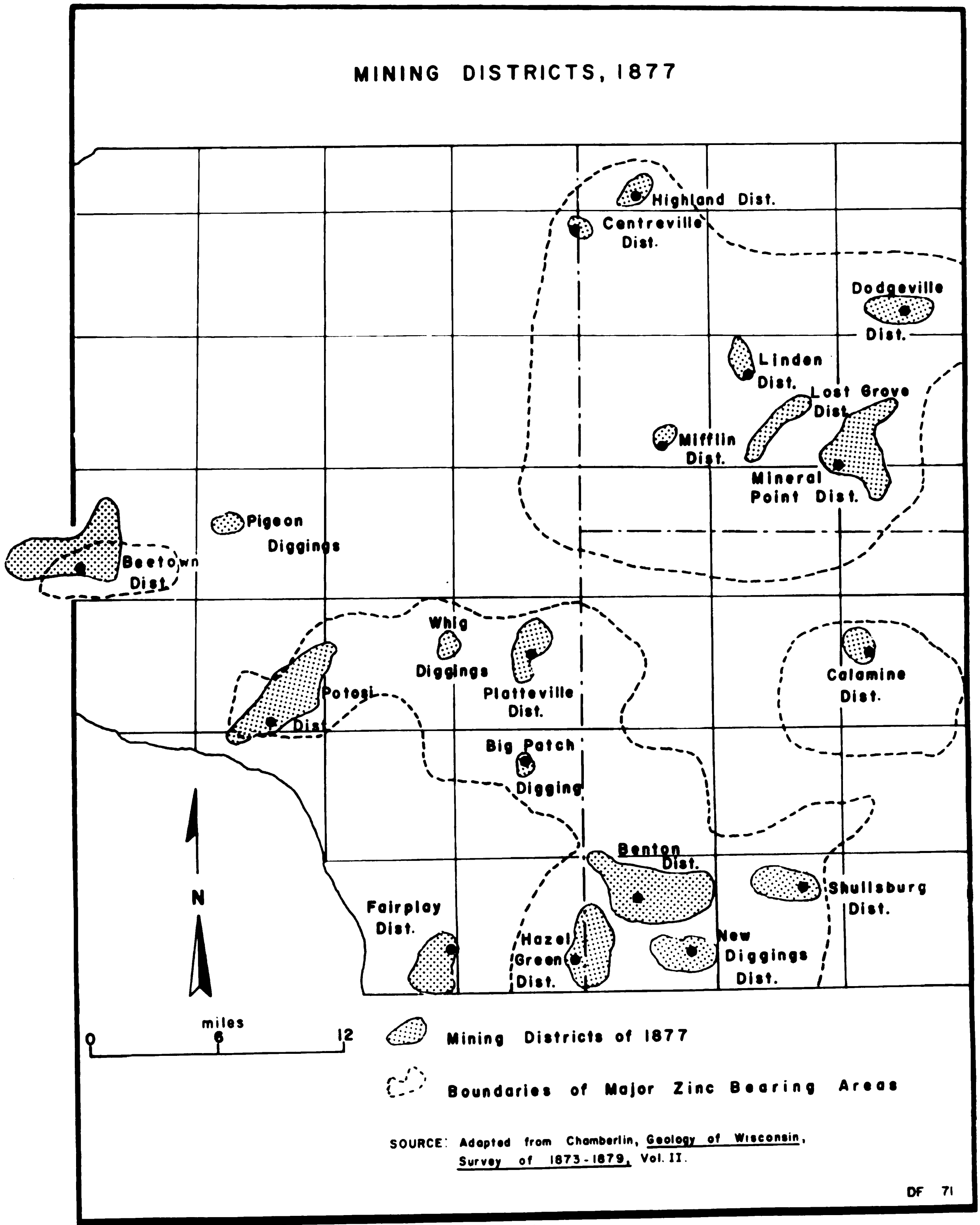
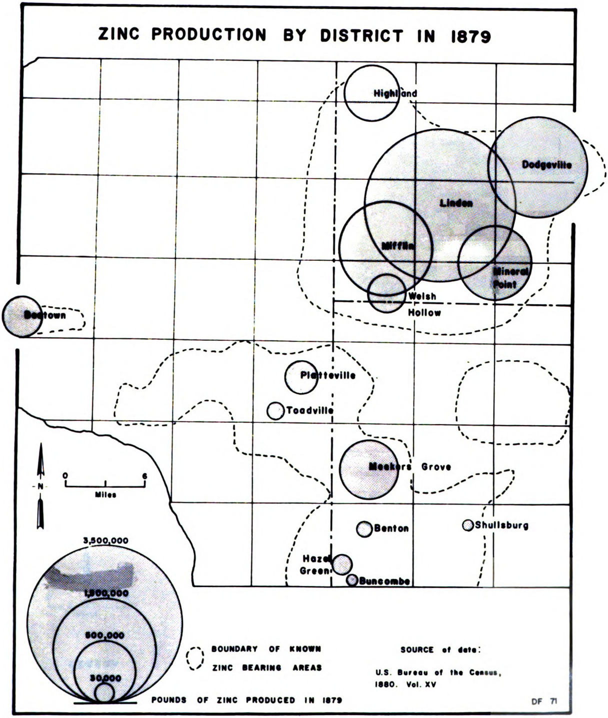
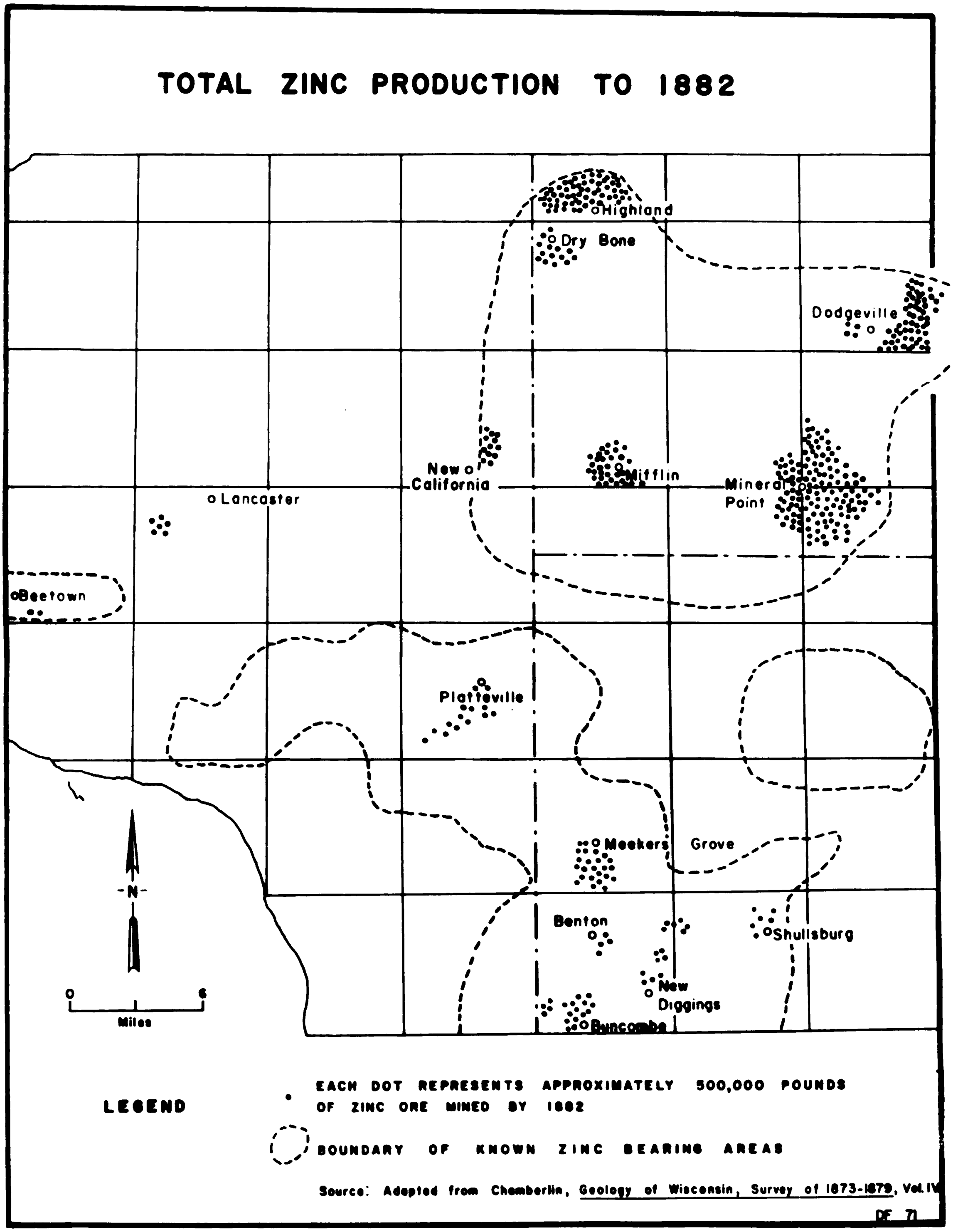
[87] *Ibid.*, May 2, 1872, p. 3.


MINING DISTRICTS, 1877
Highland Dist.
Centreville Dist.
Dodgeville Dist.
Linden Dist.
Lost Grove Dist.
Mifflin Dist.
Mineral Point Dist.
Pigeon Diggings
Beetown Dist.
Whig Diggings
Potosi Dist.
Platteville Dist.
Calamine Dist.
Big Patch Digging
Benton Dist.
Shullsburg Dist.
Fairplay Dist.
Hazel Green Dist.
New Diggings Dist.
N
miles
0 6 12
Mining Districts of 1877
Boundaries of Major Zinc Bearing Areas
SOURCE: Adapted from Chamberlin, Geology of Wisconsin, Survey of 1873-1879, Vol. II.
DF 71

MAP-7


ZINC PRODUCTION BY DISTRICT IN 1879
Highland
Dodgeville
Linden
Mifflin
Mineral Point
Welsh Hollow
Beetown
Platteville
Toadville
Meekers Grove
Benton
Shullsburg
Hazel Green
Buncombe
N
0 6
Miles
3,500,000
1,500,000
500,000
30,000
POUNDS OF ZINC PRODUCED IN 1879
BOUNDARY OF KNOWN ZINC BEARING AREAS
SOURCE of data:
U.S. Bureau of the Census, 1880. Vol. XV
DF 71

MAP-8


TOTAL ZINC PRODUCTION TO 1882
Highland
Dry Bone
Dodgeville
New California
Mifflin
Mineral Point
Lancaster
Beetown
Platteville
Meekers Grove
Benton
Shullsburg
New Diggings
Buncombe
N
0
6
Miles
LEGEND
EACH DOT REPRESENTS APPROXIMATELY 500,000 POUNDS OF ZINC ORE MINED BY 1882
BOUNDARY OF KNOWN ZINC BEARING AREAS
Source: Adapted from Chamberlin, Geology of Wisconsin, Survey of 1873-1879, Vol. IV
DF 71

MAP-9

value of the zinc ores produced in 1890 was $152,972.88 compared to $1,300.00 in 1870. In 1890 438 men and boys were employed in the county's lead and zinc mines, most were engaged in zinc production(Table I).

TABLE I

LEAD AND ZINC MINING STATISTICS, 1890
(Source: U. S. Census, 1890)

	Zinc Ore Produced (Pounds)	Value	Lead Ore Produced (Pounds)	Value
Iowa County	33,992,803	$237,462.98	811,035	$12,401.55
Lafayette County	14,264,262	152,972.88	1,457,424	27,860.80
Grant County	1,406,700	10,132.00	966,700	21,040.18
Green County	. . . .	. . . .	120,000	2,760.00
Total	49,663,765	400,567.86	3,355,159	64,062.53

	Number of Foremen	Mechanics	Miners or Operators	Laborers	Boys	Total
Iowa County	16	5	380	224	. .	625
Lafayette County	8	18	167	235	10	438
Grant County	1	1	49	27	. .	78
Green County	. .	. .	2	2	. .	4
Total	25	24	598	488	10	

In that year the mines yielded zinc over lead at a ratio of ten to one in production terms.

The principal producing zinc areas of Lafayette County in the study period were Meeker's Grove, Buncombe, and Benton. Zinc was mined in the vicinity of Meeker's Grove as early as 1865. In 1877 Strong reported four zinc yielding mines, one of which was worked solely for blende. These mines turned out relatively large amounts, two averaging about 200 tons of blende or bone per year.[88] The large production of this area was also recorded in the Census of 1880 which lists five mines with a total of 520,000 pounds of zinc. By 1882, according to Chamberlin, the mines about Meeker's Grove had yielded an accumulated total of approximately twelve million pounds of zinc ore.

Buncombe was not mentioned as a zinc area in the survey published in 1862. Strong, in his survey of 1877, indicates that at that time as well it was not particularly important although some zinc production was taking place. One mine mentioned in the Strong report employed twelve men in 1876. By the late 1870's the area was yielding considerable quantities of jack, bone, and sulphur as well as lead. Mining was carried on in most cases by drift into a hillside. In 1879 two large mines reported a combined total production of 82,000 pounds of zinc.

In his report of 1882 Chamberlin indicates that the Buncombe area had had an accumulated total output of about nine million pounds of zinc ore. However, some doubt is raised as to the validity of these figures since little zinc production took place there before 1870 and this writer found no evidence to support such a large total output as claimed by Chamberlin in 1882.

Still the Buncombe region must be considered one of the important zinc mining regions of the period, especially during its latter part. It continued to be productive during the 1880's. In 1889 some Shullsburg men began to mine jack and bone in land south of the tunnel on the Chicago and Northwestern Railroad at Buncombe. The ore was taken with little expense, as it was found near the surface.[89]

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[88] Strong, 1877, <u>op. cit.</u>, pp. 708-710.

[89] <u>Grant County Witness</u>, May 15, 1889, p. 3.

In the early part of the period under consideration Benton yielded little zinc; by the late 1870's, however, it was a major producer. Zinc was discovered in several paying lodes in 1875 and three mines were turning out ore in 1877. Some of the mines operated only during the winter, while others were active throughout the year.[90] Only one mine reported zinc production in the 1880 Census, a total of 30,000 pounds. Chamberlin recorded an output of approximately 2,000,000 pounds of zinc up to 1882 for the Benton-Leadmine district and an additional 5,000,000 pounds is shown in an area three miles to the east (Map 9).

Numerous reports of rich strikes of zinc were made in the late 1880's. Coltman and Uren's mine located between Benton and Leadmine was taking out between two and three carloads of drybone per month in early 1887. At that time they were offered $27,000 for the mine by Mineral Point parties, but refused to sell.[91] This mine had been first opened in 1877 and by 1887 was employing twelve men. In the first ten years of its operation it had yielded 1,000 tons of zinc (drybone) ore.[92] In addition to significant quantities of zinc the Benton region was also shipping out large amounts of sulphur.

Two districts of lesser significance in Lafayette County zinc mining between 1861 and 1890 were New Diggings and Shullsburg. Although considerable lead production occurred in the New Diggings area, its output of zinc was small. No mention of zinc in the area was made in

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[90]Strong, 1877, op. cit., p. 717-719.

[91]"In the Lead Region," The Miner and Manufacturer, March 26, 1887, p. 4.

[92]Ibid., April 9, 1887, p. 6.

the 1862 or 1877 surveys, but Chamberlin's 1882 map does show that about 2,000,000 pounds of ore had been produced there up to 1882. This figure is probably high and at any rate the zinc which was produced was a by-product of lead mining. As in several other districts zinc mining began to increase at the end of the period. In 1887 it was reported that zinc ore was being taken from a depth of sixty-five to seventy feet on the Bainbridge estate just north of New Diggings, with considerably more ore existing at greater depths below the water table. Fourteen men were employed in this operation.[93]

Shullsburg, formerly a great lead mining center, produced relatively little zinc before 1890. The surveys of 1862 and 1877 indicate that the Drybone Diggings northwest of the town were quite productive, but no figures were given. The Census of 1880 indicated that one mine had an output of 12,000 pounds of zinc. The Chamberlin map of 1882 shows an accumulated total output for the district of 3,000,000 pounds of zinc ore. In 1887 a former lead mine, the Baldwin, three and one half miles west of Shullsburg was being worked for bone and jack. The mine, owned by two Chicagoans and two local men, employed fifteen men and was drifted 2,000 feet into the side of a hill.[94]

Iowa County

Although rapid strides in production of zinc were being made in Lafayette County between 1861 and 1890, it still ranked far behind the yield of Iowa County. Iowa County was the pre-eminent zinc producer by any method of evaluation during the thirty-five year period. Its

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[93] Ibid., June 9, 1887, p. 6.

[94] Ibid., May 7, 1887, p. 3.

dominance was greatest during the early years when its total output of zinc ore and the value of its product surpassed its nearest competitor, Lafayette County, by ten to one margins in 1870 and 1880. The surge of production by Lafayette County miners in the late 1880's cut the lead of Iowa County by a considerable amount, but still the latter's mining dominance was impressive in 1890: zinc ore production - nearly 17,000 tons out of a Tri-County total of c.25,000 tons; value of zinc ore output - $237,462.98 of the Tri-County total value of $400,567.86; and 625 employees out of a Tri-County total of 1145.

Mining districts in Iowa County were generally more numerous than in the other counties, yet there too, the mines tended to be concentrated in only a few areas. The main districts included Highland, Linden, Dodgeville, Mifflin and Mineral Point.

Highland was founded as a result of lead mining, which was the only activity of any significance there until the 1850's. Then as agriculture became established and lead became scarce, mining waned. However, the zinc era brought new hope. Murrish, in 1871 commented:

> I speak advisedly when I say that there is zinc ore enough already discovered in the towns of Highland and Blue River to furnish (if proper encouragement was given to mining there) material for one zinc factory of large capacity for many years to come.[95]

Drybone was first discovered in 1867 southwest of Highland near Centreville. From that time on throughout the period much zinc was mined in the area, especially during the late 1870's and the 1880's. Strong, in 1877, found ten active zinc operations just northeast of the village, mainly on the Drybone Hollow Range. These diggings were close

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[95]John Murrish, "Report on the Geological Survey of the Lead Region, Wisconsin," Wisconsin State Agricultural Society Transactions, X, 1871 (Madison: Atwood and Culver, 1872), p. 475.

together and generally small - under 40 acres, except one which was 160 acres. Both blende and jack were produced from the many shafts which ranged from 25 to 100 feet deep. Some lead was also produced. Water was a problem in several mines. Bailing and hoisting was the system used in most operations, although one of the larger mines was drained by a windmill pump. This setup was fortuitous also for the operators in the processing of the ore. Since the ore had to be crushed and jigged most operators had to haul their washdirt to the closest water, about one and one quarter miles away. The windmill operators on the other hand used the water they pumped from the mine to wash the ore. Strong estimated in 1877 that the mines north of Highland were annually producing 1,000,000 pounds of lead, 1,350 tons of drybone, and 1,200 tons of blende.[96]

The area just southwest of Highland, near Centreville and Drybone, was rich in zinc. Strong mentions five operations there actively mining blende and drybone in 1877. An Iowa County history published in 1881 reported enormous quantities of zinc ore being produced in the Highland region,[97] while Chamberlin indicates that about 28,000,000 pounds of zinc ore had been produced by 1882.

In the Linden district, about eleven miles southeast of Highland, some zinc had been produced as early as 1869, but major production did not begin until 1874-1875. Strong found eight active operations in 1877, including two large ones - the Linden Mining Company mine (owned by Ross and Henry of Mineral Point) and the Robarts mine. The former was the principal zinc mine of the Linden region and one of the major producers

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[96]Strong, 1877, op. cit., p. 723-726.

[97]History of Iowa County (Chicago: Western Historical Company, 1881), p. 795.

of the entire district. It had been worked for lead between 1833 and 1866. After 1874, the date of purchase by Mineral Point men, it was operated primarily for jack and bone. Much capital was invested in putting the mine back on the active list. It was equipped with new engines and a lift pump, and the old drifts and shafts were cleaned out. Relatively modern for its day, the mine introduced the Ingersoll pneumatic drill with air compressor into the area, and was the first to use Rend rock (a new explosive) extensively. In 1877 it furnished employment for 180 persons, and produced an average of twenty tons of zinc per day.[98]

The Linden district appears in the 1880 Census records, having eight operations with nearly 3,500,000 pounds of zinc produced. Oddly the Linden district does not appear as a zinc producer at all on Chamberlin's map of 1882 (Map 9). This undoubtedly was a simple omission on his part, and must be considered an error.

Most of the zinc ore yielded in the Dodgeville district was from mines two to three miles east of town. Many small mines produced only lead ore, and very few produced only zinc ore. Strong devoted little space to the area's zinc output in 1877, yet it appeared as one of the leading zinc districts in the Census of 1880, and Chamberlin indicated that it had produced a cumulative total of 31,000,000 pounds of zinc ore by 1882.

Whitney in 1862 reported much jack mixed with lead in the Mifflin area, but little mining was then being done. By 1877 Strong noted three active zinc mines producing a total of about 880 tons of the ore making the Mifflin region one of the larger producers in the entire Tri-County area. One and one third million pounds of zinc were produced by three

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[98]Strong, 1877, op. cit., p. 726-729.

Mifflin area mines according to the Census of 1880, and by 1882 this region had produced a total of 16,000,000 pounds of zinc ore. In addition to the immediate Mifflin vicinity, an area to the south known as the Welsh Settlement was also producing zinc ore, as was also the Coker mine located about two miles west of Mifflin. The Coker mine and the Penitentiary mine in Mifflin are worthy of special mention, for they were two of the greatest mines in the history of the district. They had their start in the period under study.

The Penitentiary mine, also known as the Peni or Blackjack had produced zinc since 1862 and yielded considerable amounts of lead before that. It was a wet mine, being drained through the level which contained the tramway used to move rock and ore to the surface. Enough water was taken from the mine to operate a wash place near the entrance. It was also a large mine. A distance of 1700 feet separated the entrance and the forehead. Fifteen men were employed in 1877.[99]

The Coker mine, on the Ellsworth farm, was in its early stages in 1881. Owned by a Mr. Coker and a Mr. Jeffrey, the operation employed twenty men working in two shifts. The chief work at that time was confined to constructing a sixty foot shaft and running a level. Little actual ore production took place.[100] More capital expenditures were said to be needed in "buildings, and machinery necessary for cleaning, hoisting, and accommodations for employees before winter sets in."[101] Evidently the expenditures were made and the mine became profitable; in fact other

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[99] Ibid., p. 721-722.

[100] George and Robert Crawford (eds), Memoirs of Iowa County, Wisconsin, I (Northwestern Historical Association, 1913), p. 226.

[101] Ibid.

mines began to operate on the same range. In 1890 the Grant County Witness reported that "the Coker mines are doing well for all concerned, mining is quite a craze in this vicinity, [Livingston area] a large number being employed in it."[102]

Mifflin became a thriving village on the basis of the zinc boom in the 1870's and 1880's. It had over 200 people, with two drygoods stores, two blacksmith shops, two wagon shops, one hotel, a town hall, one church, one grade school and two temperance saloons.[103] Thirty men were employed by three mining companies in 1881, and at one end of town one steam and five horse crushers were at work cleaning zinc ore.[104]

The city of Mineral Point had long been looked upon as a center of the mining industry. With the decline of lead, however, the city had also experienced a decline. Mining for lead continued to decrease while that for zinc increased, but in general mining there was highly sporadic during the 1860's and early 1870's. By the late 1870's mining around Mineral Point began to pick up markedly. Strong, in 1877, found forty active mines in and around Mineral Point, including Diamond Grove and Lost Grove. Many of these mines were quite small; they were two, three and four man operations and frequently were worked only during the winter months.[105] Strong gives little indication of the actual output of zinc in 1877, but it must have been considerable for he commented that the Mineral Point area was shipping a large portion of the zinc produced in southwest Wisconsin. In 1880 only eight operations

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[102] Grant County Witness, January 15, 1890.

[103] Ibid., December 20, 1877.

[104] Ibid., August 10, 1882.

[105] Strong, 1877, op. cit., p. 733-739.

were reported and their combined production was 894,000 pounds of ore. By 1882 Chamberlin estimated approximately 69,000,000 pounds of zinc ore had been produced in the immediate vicinity (within two miles) and in the town itself with an additional 7,000,000 pounds in the Lost Grove district three miles to the southwest. By 1890 there were more paying mines operating in and around Mineral Point than at any other time in the period.[106]

Grant County

Grant County had been an early and large producer of lead ore. Many of its chief settlements, including Platteville, Hazel Green and Potosi were founded as a result of lead mining. However with but a few exceptions zinc mining was not engaged in on a very large scale between 1861 and 1895.

Platteville was one of the exceptions, and the Platteville area was an early Tri-County producer of zinc. By 1860 small quantities of drybone were being produced from the "Drybone Range" and in that year a sheet of blende was discovered in the same vicinity.[107] However according to the Census of 1870 there were no zinc ore producing mines in Grant County at that time. It was reported in another source in the same year, however, that "there are in Grant County immense deposits of lead and zinc still undeveloped."[108] During the 1870's additional deposits of jack and bone were discovered and exploited. In the Platteville

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[106]"History and Guide to Mineral Point," (manuscript) WPA Federal Writers Project, 1941.

[107]Hall and Whitney, op. cit., p. 314.

[108]Transactions Wisconsin State Agricultural Society, 1870, op. cit., p. 412.

vicinity (Big Patch and Whig) two small operations were producing zinc ore in 1877.[109] Two other small areas of zinc production in Grant County prior to 1890 were Pigeon Diggings, where drybone was discovered in 1876 and at Crawford Mills and Company land near Hazel Green. This company, also known as the Hazel Green Mining Company, was a very large mining land owner, but most of the ore produced on its property was lead. Beginning in 1874 and 1875, however, two operations on these holdings were producing zinc ore in small quantities.[110]

Of the zinc mines in Grant County operating between 1861 and 1890, one of the most important was the Wilcox Diggings, later called the Beetown Mine, and located near Beetown. Work in the mine commenced in 1868 after it was drained by a level. In 1877 four men were employed in mining both types of zinc ore and also lead. Its production of 120 tons of zinc ore in 1880 was more than one half of Grant County's total production in that year.[111]

By 1890 zinc ore production had increased to over 700 tons as compared to 220 tons in 1888. In spite of this increase Grant County's total still represented only 3% of the entire district's production. Also in contrast to the other two mining counties, Grant's lead ore production was still more valuable than its zinc - in fact more than twice as valuable (Table 1).

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[109] Strong, op. cit., p. 720.

[110] Ibid., p. 696.

[111] U. S. Bureau of the Census, 1880, op. cit., p. 979.

Zinc Processing

Zinc ores, unlike those of lead, needed considerable, technical and costly processing before they achieved a form used by fabricators. Processing of lead was simple and cheap and was carried on throughout the Lead Region. Long after the peak of lead production had been reached, there were still fifteen lead furnaces in operation in southwest Wisconsin (Map 10). Strong reported (1877): "The lead ore produced in each district is seldom exported from it as such, but is usually reduced by the furnaces of that district, and then exported as pig lead."[112] In contrast, because of the complicated treatment necessary for the smelting of zinc ores, they were seldom processed beyond the first stage of reduction in the region; in fact, during much of the period under study, large quantities of ore were shipped out in crude form.

As the raw ore came from the mine some of it, especially the blende, was sufficiently rich that it could be shipped directly to the smelter. More frequently, however, a simple mechanical operation was applied first. This was crushing and jigging. The latter was a process that utilized the principle of specific gravity to separate, after crushing, the heavier ore from the waste material. This was done by "jigging" or shaking a box which was perforated at the base and contained the ore, in a large box of water. It was usually a hand operation (Figure 8). Unfortunately it was a relatively inefficient process and left much of the ore unsaleable. This was caused primarily by the fact that there was an intimate mixture of zinc, pyrite and rock which were difficult to separate. Chamberlin recognized the problem and suggested that the employment of a new type of jigging machine would allow the utilization of a

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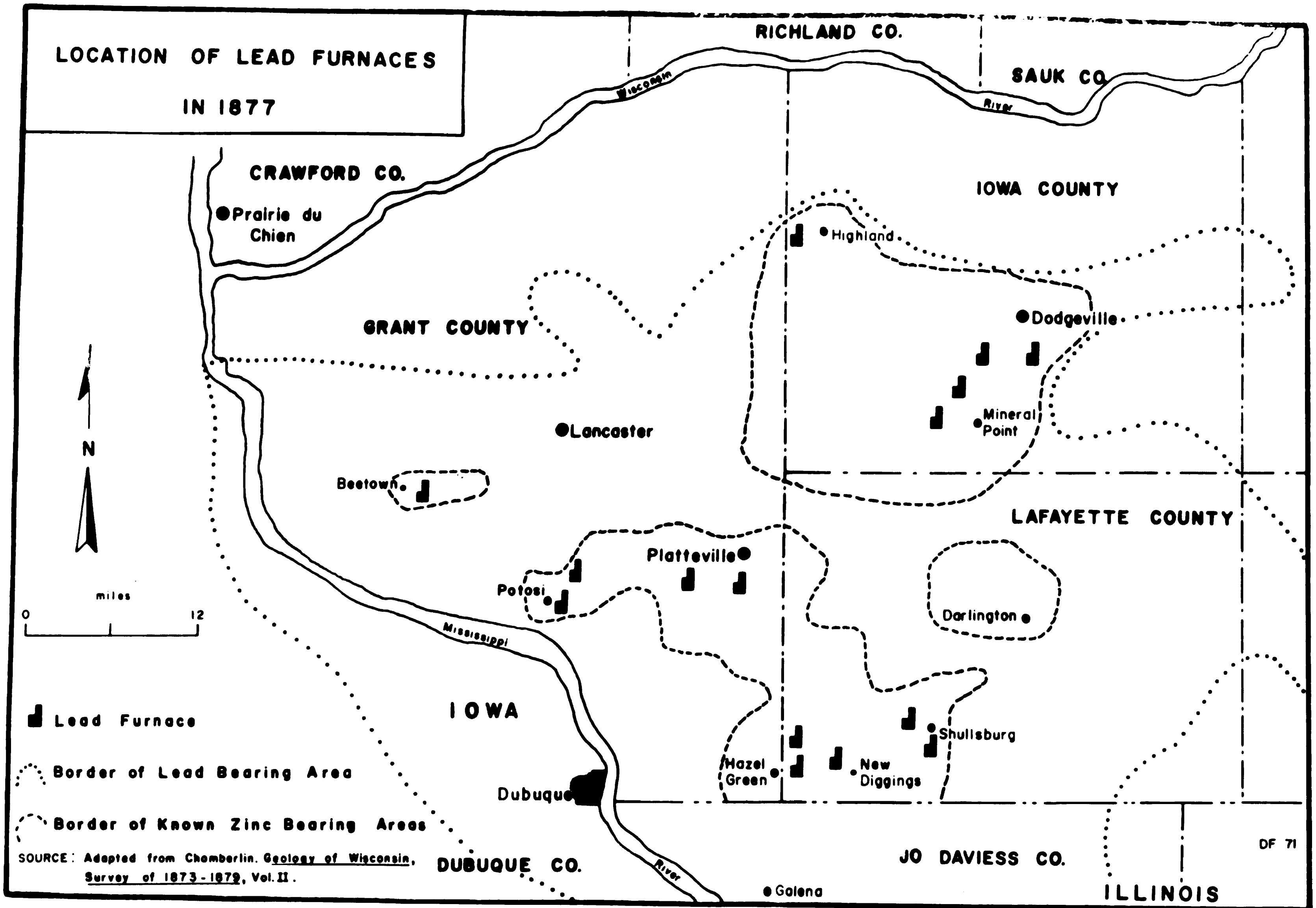
[112]Strong, 1877, op. cit., p. 744.


LOCATION OF LEAD FURNACES IN 1877
RICHLAND CO.
SAUK CO.
Wisconsin River
CRAWFORD CO.
Prairie du Chien
IOWA COUNTY
Highland
Dodgeville
Mineral Point
GRANT COUNTY
Lancaster
Beetown
LAFAYETTE COUNTY
Platteville
Potosi
Darlington
Mississippi River
IOWA
Shullsburg
Hazel Green
New Diggings
Dubuque
DUBUQUE CO.
JO DAVIESS CO.
Galena
ILLINOIS
DF 71
N
miles
0
12
Lead Furnace
Border of Lead Bearing Area
Border of Known Zinc Bearing Areas
SOURCE: Adapted from Chamberlin, Geology of Wisconsin, Survey of 1873-1879, Vol. II.

MAP-10

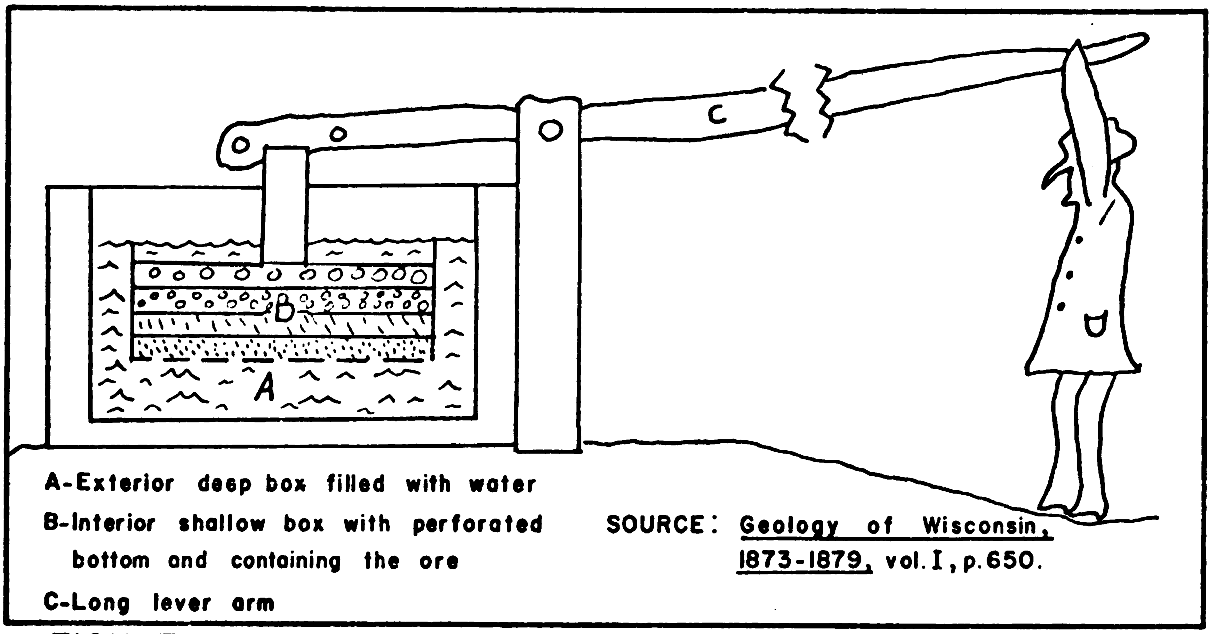


FIGURE 8. Jigging Device

large amount of poor zinc that was being thrown away.[113] Before his suggestion could be acted upon southwest Wisconsin had a large smelting factory.

Although the blende was subjected to little if any processing at the mine, the drybone was almost always roasted (or calcined) before it

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[113]Strong, 1883, op. cit., p. 652.

was shipped to the smelter. The roasting was done in a small furnace that resembled a lime kiln; it cost approximately $300. A fire was built in the furnace bottom and then layers of bituminous coal and ore were gradually added until the furnace was nearly full. Its capacity was approximately sixty tons of raw ore, and about twenty-five tons of ore were roasted in twenty-four hours. As fast as the ores were calcined they were withdrawn through doors at the furnace base. The job required the labor of six men working two at a time in three, eight hour shifts. From 80 to 100 pounds of bituminous coal were needed to reduce each ton of ore. The cost was fifty to sixty cents to produce each ton of roasted ore. The purpose of this operation was to remove the carbonic acid from the ore (constituting about one-third of the ore's weight) and the small amount of water present.[114]

As mentioned in Chapter One, a significant reason for the lack of zinc mining development prior to 1860 was the absence of a large, nearby market for the ore. The emergence of the industry in Wisconsin after 1860 was due in part to the increased knowledge of the ores, the economies of large scale lead mining, the introduction of quantities of capital to intensify the mining process, and perhaps most significant, the establishment of zinc smelters in the region or nearby.

Early United States processing

Zinc oxide was being manufactured successfully in the United States as early as 1850 in New Jersey, and subsequently in Pennsylvania and Tennessee. Zinc metal (called spelter in the early days and now slab zinc) was first produced in this country in 1838[115] at the government

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[114]Strong, 1877, op. cit., p. 742 and Strong, 1883, op. cit., p. 665.

[115]Another date given for this first production is 1835.

arsenal in Washington, D. C. from New Jersey zinc ores. This output was ordered by Congress in order to manufacture brass designs of standard weights and measures. However, the process utilized was so expensive that no effort was made to manufacture zinc commercially in the same manner. Other attempts were made to produce spelter: 1850 in Newark, New Jersey, 1855 in Potosi, Missouri, 1856 at Bethlehem, Pennsylvania, and 1857 at Calamine, Arkansas. All were unsuccessful.[116] The first commercially successful production of zinc metal in the United States took place at La Salle, Illinois, in 1859-60.

The relationship of the construction of the smelter at LaSalle and the utilization of Wisconsin zinc ore was very significant. In 1857 F. W. Mathiessen and Julius Hegeler, fresh from the School of Mines at Freiberg, Germany, arrived in this country. They were interested in developing a zinc smelting plant and received permission from the Lehigh Zinc Company to experiment at its abandoned operation (presumably in Bethlehem, Pennsylvania). The two men did produce some spelter economically by a technique which they developed, but since sufficient capital for expansion and improvement of the new process could not be raised (they were also not able to reach an agreement with the Lehigh Zinc Company as to financial remuneration for its use of their method of smelting) they left the East for the Midwest. Having heard of the large Wisconsin zinc deposits, they visited the southwest part of the state during 1858 and were evidently convinced of the abundance and satisfactory quality of the zinc ores that existed there. Late in 1858 they began construction of a zinc smelting

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[116] Clark, op. cit., pp. 97-98; Walter R. Ingalls, Production and Properties of Zinc (New York: Engineering and Mining Journal, 1902), pp. 13-14; C. H. Mathewson (ed.), Zinc: The Science and Technology of the Metal, Its Alloys and Compounds (New York: Reinhold Publishing Corp., 1959), pp. 4-6.

plant at La Salle, Illinois. This particular site was chosen because it was on the closest large coal field (coal was needed in substantial quantities for the smelting furnaces) and abundant fire clay was near at hand.[117] The site of the plant was virtually over a coal mine.

An early Wisconsin processor

Another effort at smelting zinc in the area which eventually gave great stimulation to Wisconsin's zinc industry was that which began in Mineral Point in 1859. This was started by Robert George, a Mineral Point resident, a native of Prussia. George, sometimes called Georgi, was a former superintendant of mining and smelting for the Prussian government and a graduate of Breslau University.[118] In association with some capitalists of eastern Pennsylvania, George built a furnace at Mineral Point in which he proposed to smelt zinc and other ores at considerable savings over old methods. According to Whitney's observations in 1859 and 1860, however, very little zinc metal was produced during those years at the Mineral Point furnace; at most two to three tons.[119]

In 1862 George contracted Moses Strong, well-known financier of the Lead Region, to sell and dispose of the rights to his new smelting method. Apparently the several problems which George had encountered, including the securing of fuel and suitable fire clay, led him to abandon the idea of smelting at his own furnace but he still wanted to capitalize on his process. Strong was to receive a commission of 33% of all sums which might be

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[117]Ingalls, op. cit., p. 14.

[118]Moses Strong Collection, Library of the Historical Society of Wisconsin, Madison, Manuscript Collection, printed document entitled Explanatory Statement, printed about May, 1862.

[119]Hall and Whitney, op. cit., p. 371.

received from the sale of the process. Many individuals and companies throughout the nation were contacted, but apparently to no avail, for in November, 1862 George was working as a chemist at the Smith and Rand Powder Company in the East.[120]

Rapid expansion of the industry

Although George's attempt at smelting in Mineral Point was financially unsuccessful, it did aid in attracting a large eastern industrial firm into the area for the purpose of smelting zinc. In 1863 the firm of Phelps, Dodge and Company began construction in Mineral Point, spending huge sums of money to erect furnaces and other buildings, and within one year were in full operation. Thus, the mines of southwest Wisconsin had a local outlet for their zinc ore.

With the establishment of the La Salle and Mineral Point smelters, zinc production in the Tri-County region began on a relatively continuous basis. It was not, however, until after the end of the depression which followed the outbreak of the Civil War that the industry really started to boom. The war demands for zinc in arms and cartridges manufacture was a leading factor in putting the industry on a firm footing. Figure 6 shows the production of zinc before the Civil War was less than 200 short tons. From 1861 to 1863 the output increased fourfold and in the next biennium (1863-1865) again nearly quadrupled.

Prices for zinc ore were also affected by Civil War demand. During the late 1850's and early 1860's when smelting was in an experimental stage, there was little market and the smelters could obtain the ore very cheaply. In many cases it was available merely for the cost of

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[120] Moses Strong Manuscript Collection, op. cit., correspondence between Strong and George, April, 1862 to November, 1862.

hauling it from mine refuse dumps. Some accounts indicate a price of $4 per ton paid to the miners for the ore in the earliest days. By the end of the war, however, smelters were paying $10-15 per ton and were happy to get it at that price.

The Phelps-Dodge works

The two smelters previously discussed prospered and expanded during the war boom. Mathiessen and Hegeler's operation in LaSalle was one of the world's largest zinc processing establishments by the end of the war. The Phelps-Dodge works in Mineral Point was also of national significance and is of more direct concern to this paper since it was located in the area of study.

The Phelps-Dodge plant was located at a place known as Bellevue, one half mile south of Mineral Point's business district. It was just off the main line of the Mineral Point Railroad, with which it was connected by a side track. The operation contained numerous buildings, furnaces and equipment necessary to produce zinc on a large scale. Also included was the house of the plant superintendent. During the period of peak production (the late Civil War years and immediately thereafter) the company employed 150 persons daily. Both spelter and zinc white[121] were produced at an estimated profit of $100 per day.[122]

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[121]In Transactions of the Wisconsin Agricultural Society of 1869, pp. 44 and 47, it is stated that the smelter industry had been entirely transferred to Illinois and the Mineral Point plant was producing only zinc oxide in the late 1860's.

[122]History of Iowa County, op. cit., p. 700.

Wisconsin loses the zinc processing industry

Since the zinc works was owned and managed by easterners, it had little if any sentimental attachment to the Mineral Point area. There was no inclination on the part of these men to continue its operation if their profit was not what they thought it should be. Thus in 1869, after an investment of over $300,000 during its five to six years of operation, the doors of the Phelps-Dodge works were closed and the company moved to central Illinois. Two main reasons have been given to explain the move. The first was the high cost of transporting coal and fire clay from central Illinois. The amounts of coal and clay used exceeded the tonnage of ore utilized at the smelter. The second was the various difficulties that the company had with the Mineral Point Railroad from whom they were unable to obtain necessary accommodations.[123]

The withdrawal of the zinc works from Mineral Point resulted not only in the unemployment of large numbers of people in the city, and the obvious economic loss for the city as well, but the entire mining region suffered in that there was no longer a local outlet for the zinc ore. Consequently, until 1882 southwest Wisconsin's zinc ore had to be transported out of the region for smelting, which meant lower profits to the miners. Most of the ore which formerly went to Mineral Point was now diverted to the several smelters which had recently been established in central Illinois (e.g. the Illinois Zinc Company had built a plant at Peru in 1870). Of course, some Wisconsin ore had been going to Illinois since 1860.[124] Other destinations of the ore included smelters at

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[123] History of Grant County, Wisconsin (Chicago: Western Historical Co., 1881), History of Iowa County, op. cit., p. 165; 700. "History and Guide to Mineral Point," op. cit., p. 27.

[124] The development of the zinc mines in Wisconsin and of the zinc

St. Louis[125] and Carondelette, Missouri.[126]

The lack of zinc processing facilities in Wisconsin was disturbing to many. Governor Washburn, for example, enjoined the Legislature in 1873 to find the means to encourage the manufacture of zinc in the state in order that the native zinc could contribute its part to the economy. He pointed out that "large amounts of ore are mined and sent to La Salle and Peru, Illinois to be converted into spelter and oxide of zinc at a great profit to the manufacturer. It is hoped that the day is not distant when the ores may be reduced within the limits of the state."[127] It was not until ten years later, though, that any positive action was taken. In 1883 a law was passed exempting from state taxation all property of any corporation engaged in the manufacture of oxide or metallic zinc from native Wisconsin ores. The exemption period was three years.[128] By this time the new Mineral Point zinc works, described below, had already commenced operations, so the new law attracted no additional plants.

The main reason for the lack of a Wisconsin zinc smelting industry was the absence of abundant and cheap fuel in the state.[129] It was less expensive to transport the ore to the furnaces on the coal fields in

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smelters in Illinois was mutually dependent upon the other. The zinc miners relied upon the Illinois smelters as their major market. The smelters in return derived their entire supply of ore from the Upper Mississippi Valley district (mainly Wisconsin) until the 1870's when zinc from the Joplin, Missouri district began moving to the Illinois coal fields.

125 Transactions of the Wisconsin State Agricultural Society, 1870, op. cit., p. 419.

126 Dodgeville Sun, (Dodgeville, Wisconsin), 1906.

127 Grant County Witness, January 23, 1873.

128 Lake, op. cit., p. 168.

129 I. A. Lapham, op. cit., p. 11.

northern Illinois than to ship the coal to the mining region.[130] The State Geologist, I. A. Lapham, suggested in 1873 a possible way to bring a smelter to Wisconsin. He wrote: "The construction of a railroad from Milwaukee directly to the source of supply of these zinc ores, by cheapening the cost of transportation, might render the manufacture of spelter and zinc white, a business of profit on the shores of Lake Michigan."[131] This never came to pass. Another problem was the uncertainty associated with the Wisconsin ore deposits. Were these of sufficient size and quality to sustain a large smelting industry for a sufficient period of time to return a profit on the large investment that was necessary?

Continuing national development of the zinc industry

Meanwhile, the zinc industry in the nation as a whole was attaining greater and greater significance. Huge ore deposits were being worked for the first time in the late 1860's and early 1870's in the old Potosi and the new Joplin mining regions of Missouri. The latter area, along with adjacent regions of Kansas and Oklahoma, was to become a major United States zinc producer and has been known as the Tri-State District. Midwestern zinc smelters increased in number from four before 1870 (Wisconsin 1, Illinois 1, St. Louis of Missouri 2)[132] to six in 1880 (La Salle, Illinois 2, Peru, Illinois 1, St. Louis 3).[133] It was also reported that new zinc works had been established in Kansas

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[130] Strong, 1883, op. cit., p. 654.

[131] I. A. Lapham, op. cit., p. 11.

[132] U. S. Bureau of the Census, Ninth Census of the United States: 1870, III, 398.

[133] U. S. Bureau of the Census, 1880, op. cit., pp. 981-982.

and Missouri in 1881 and 1882.[134] The result was that production of zinc metal in the United States jumped from next to nothing in 1870 to 21,080 metric tons in 1880.[135] Zinc was in great demand. The chief uses in the 1870's were in the manufacturing of brass, bathtubs, signs, organ pipes, nails, and in galvanizing iron. Zinc white had also achieved prominence, for it had become second only to white lead in importance as a white pigment in paint and was extensively manufactured in the United States by 1880.[136] It was also suggested that zinc could be utilized as a roofing material,[137] but there is no evidence to support a widespread use for that purpose during the period under study.

The Mineral Point zinc works

With the future of the industry apparently bright, and undoubtedly having in mind the optimistic reports about the Wisconsin zinc deposits made by Strong and Chamberlin, the people of Mineral Point raised the question of the feasibility of reestablishing a smelter in the area. At a meeting on March 10, 1882 a committee was appointed to look into the matter.[138] A few days later the articles of incorporation of the Mineral Point Zinc Company were drawn up and signed by Alex Wilson, James Toay, Sr., Jonothan H. Vivian, R. D. Pulford, Phil Allen, Jr., and N. H. Snow. There was a significant difference between the new company and the old Phelps-Dodge works in that the new one was organized,

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[134] U. S. Geological Survey, Mineral Resources of the U. S., 1882-1883 (Washington: Government Printing Office), p. 474.

[135] Ingalls, op. cit., p. 71.

[136] U. S. Geological Survey, op. cit., p. 921.

[137] Gregory, 1870, op. cit., p. 161.

[138] Crawford, op. cit., p. 197.

owned and managed by leading local citizens. The capitalization of $35,000 consisted of 350 shares at $100 each.[139] Construction of the plant began in mid-April, 1882. It was located in the valley at the east edge of the city on the main line of the Milwaukee and St. Paul Railroad (formerly the Mineral Point Railroad), just southeast of the railroad depot. The following November the furnaces were charged with local ore and Illinois coal, and the company began to turn out its principal product - zinc oxide. According to the editor of the Mineral Point Tribune "the hum-um-mum, hum-um-mum of the fans at the zinc works is music. . . . Samples of oxide shown at yesterday noon, are declared by competent judges to be of the best quality."[140] Although the zinc works, with a daily capacity of six tons of oxide, was evidently a successful operation, it did have a serious drawback in the lack of capital. Shortly after its successful initiation the Mineral Point Zinc Company was offered for sale. David B. Jones, a Chicago lawyer and former resident of Iowa County, saw in the company an opportunity for profit by enlarging it, and he therefore purchased the works on March 18, 1883. The next year Jones formed a partnership with his two brothers, William A., who resided in Mineral Point, and Thomas D. Jones.[141] William A. Jones resigned his position as cashier of the Mineral Point First National Bank in 1887 and became the general manager of the zinc works. In 1893 David was the company's president, Thomas the vice-president,

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139 Library of the Historical Society of Wisconsin, Madison, Manuscript Collection, "History of Mineral Point," (nd), p. 19.

140 Mineral Point Tribune (Mineral Point, Wisconsin), November 16, 1882.

141 "History and Guide to Mineral Point," p. 233. (Note: another source, i.e., Fiedler, History of Mineral Point, p. 147, states that in 1883 three brothers, William A., David B., and Thomas D. Jones bought the Mineral Point Zinc Company).

and William the secretary-treasurer.

The Jones brothers raised the capitalization to $400,000 and gave effective management to the operation. These men undoubtedly wished to have their home region prosper, as well as make a profit for themselves. They had faith in the Wisconsin zinc industry and they displayed this by continually expanding and improving their holdings. Their faith was repaid, for in spite of national and regional recessions, and several costly fires (e.g. March 4, 1884), the Zinc Company flourished. It was reported in 1885 to be turning out eighty to eighty-five barrels per day.[142] In 1887 it was running days, nights, Sundays, and employed thirty men.[143] By 1891 the plant capacity had been increased to twenty tons of oxide per day, and its physical facilities expanded to cover two acres at the original site. One hundred men staffed the plant during its twenty-four hour per day, seven-day per week operation. It was considered to be the largest oxide plant in the United States at that time. Improvements then underway destined it to become one of, if not, the largest oxide plant in the world.[144]

Not only did the Mineral Point Zinc Company make a significant economic contribution to the city and provide a local market for the zinc ores of southwest Wisconsin,[145] but it also was responsible for another step in progress. Since the plant had to operate both day and night and was a large consumer of fuel, the company decided to build

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[142] Grant County Witness, October 22, 1885.

[143] "In the Lead Region," op. cit., April 9, 1887, p. 6.

[144] Iowa County Democrat, Special Edition (Dodgeville, Wisconsin), 1891, p. 5.

[145] The Company also owned high quality zinc mines in Hanover, New Mexico, which supplied ore to the plant between 1891 and 1893.

its own electric plant. In 1891 they negotiated successfully with the Mineral Point Town Council and contracted to furnish the city with ninety-nine lights for commercial and residential use.[146] Thus because of the development of the zinc industry, Mineral Point received electric lighting earlier than any other town in the region.

Rail Transportation and the Zinc Industry

Fortunately for the mining industry transportation facilities were being developed in southwest Wisconsin between 1860 and 1895 (Map 11). The railroad building era of the Midwest was beginning its full swing. Several lines had been built and were being utilized by the miners and ore processors before the Phelps-Dodge smelter in Mineral Point closed its doors; several more were in the paper or construction stage. Rail transportation was an integral part of the success of early zinc development and played an increasingly important role in the continued development of the region, especially after the Phelps-Dodge Company shut down its Mineral Point plant. During the height of the Lead Era the great need for a railroad to link Milwaukee and the Mississippi River was recognized. Milwaukee interests wished to connect their port city with the producing areas of mineral, livestock, and agricultural commodities. Thus, in 1847 the Legislature granted the charter for the Milwaukee and Waukesha Railroad Company.[147] The charter was amended in 1848, changing the name to the Milwaukee and Mississippi Railroad Company and authorizing the building of the line to a Mississippi River terminal in Grant County.

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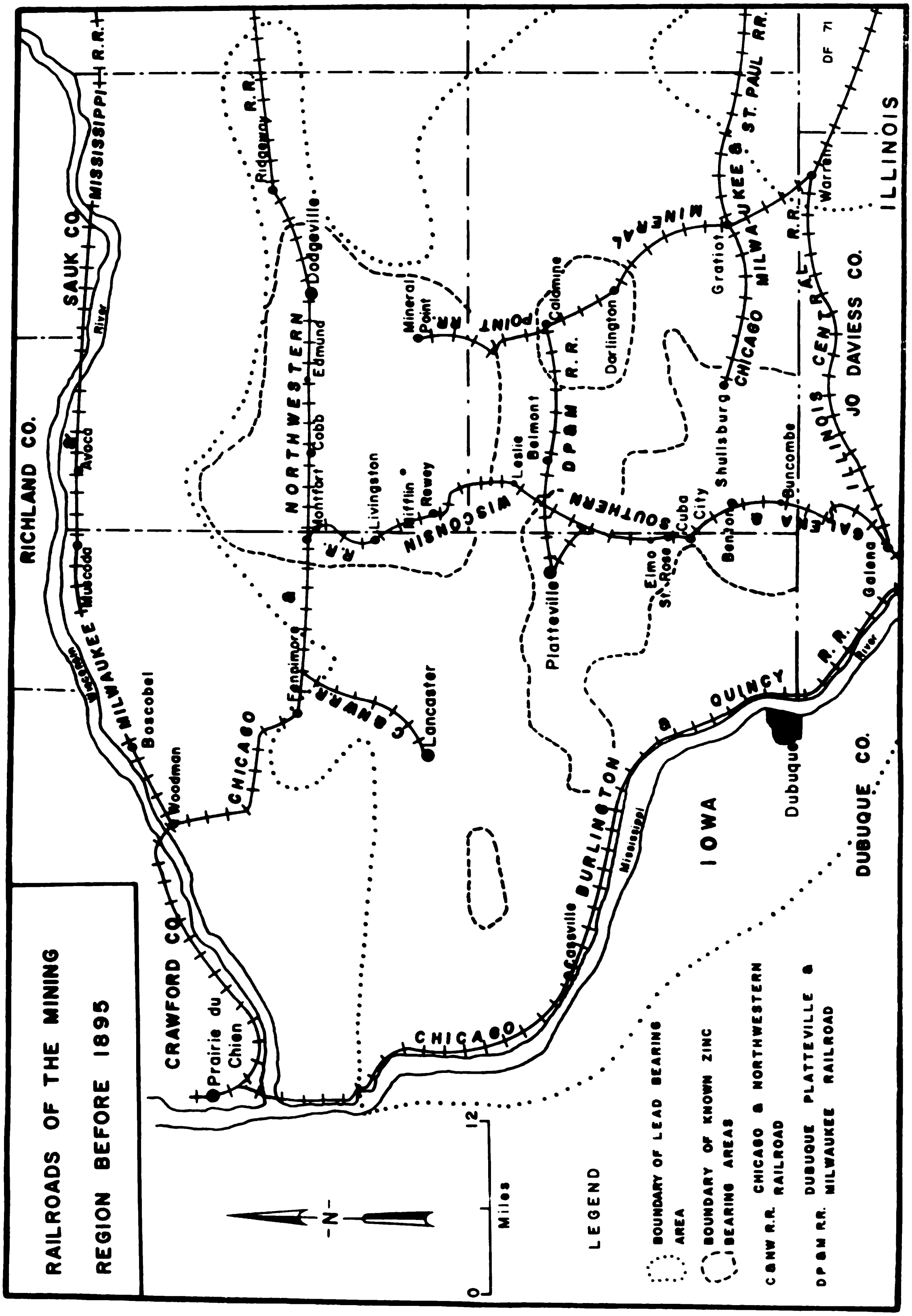
[146] Iowa County Democrat, op. cit.

[147] There was no general railroad law in Wisconsin until 1872. Until that time all companies formed for the construction of railroads were incorporated by special charter of the State Legislature.


RAILROADS OF THE MINING REGION BEFORE 1895
LEGEND
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREAS
C&NW R.R. CHICAGO & NORTHWESTERN RAILROAD
DP&M R.R. DUBUQUE PLATTEVILLE & MILWAUKEE RAILROAD
-N-
0
12
Miles
RICHLAND CO.
SAUK CO.
CRAWFORD CO.
IOWA
DUBUQUE CO.
JO DAVIESS CO.
ILLINOIS
MILWAUKEE & MISSISSIPPI R.R.
CHICAGO & NORTHWESTERN R.R.
CHICAGO BURLINGTON & QUINCY R.R.
CHICAGO MILWAUKEE & ST. PAUL RR.
ILLINOIS CENTRAL R.R.
GALENA
WISCONSIN
SOUTHERN
MINERAL POINT RR
DP&M R.R.
Wisconsin River
Mississippi River
Prairie du Chien
Woodman
Boscobel
Muscoda
Avoca
Ridgeway
Dodgeville
Edmund
Cobb
Montfort
Livingston
Mifflin
Rewey
Fennimore
Lancaster
Mineral Point
Calamine
Darlington
Belmont
Leslie
Platteville
Elmo
St. Rose
Cuba City
Shullsburg
Gratiot
Benton
Buncombe
Galena
Warren
Cassville
Dubuque
MAP-11

The rail head moved steadily westward: to Waukesha in 1851, Milton in 1852, Stoughton in 1853, and Madison in 1854.

Residents of the Lead Region hoped that the railroad would pass through southwest Wisconsin's most prosperous cities. In this way there would be great savings for the mining industry and also an aid for agriculture and the general development of the region. Although the railroad officials recognized the value of the lead trade, it was decided it would be too costly to have their line pass through the rugged hill country around Dodgeville, Mineral Point and Platteville. Following advice of the company's surveyor, who reported the land formation of the Lead Region was not suited to cheap railroad construction, the track was laid along the valley of the Wisconsin River westward from Madison.[148] This route, which passed through several towns in northern Iowa and Grant Counties and reached Prairie du Chien on the Mississippi River in 1856, was well to the north of the heart of the mineral district.

The fact that the Milwaukee and Mississippi Railroad was not built through the mining district is a strong indication that agriculture had replaced mining as the major economic activity of western Wisconsin. The railroad was successful without the shipment of significant quantities of mineral products. The Grant County Witness of November 3, 1859 reported that the railroad was doing a large volume of business shipping cattle, grains, and goods to the East and that extra trains were needed to care for the shipments.

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[148] August Derleth, The Milwaukee Road (New York: Stratford Press, 1948), p. 51.

Mineral Point Railroad

Although the Lead Region was bypassed by the first rail line built through southwest Wisconsin, it was not long before rails were being laid to serve the mining interests. The major line of the mineral district, and the only one for many years, was the Mineral Point Railroad. The company was chartered by the Legislature and incorporated in 1852. After considerable financial difficulty and a change in ownership, the railroad was completed in 1855. It traversed the thirty-one miles between Mineral Point and Warren, Illinois, where it met the Chicago and Galena Railroad (a part of the Illinois Central).[149]

The financial panic of 1857 reached southwest Wisconsin and the depression of 1858 was severely felt. There was still much traffic on the Mineral Point Railroad, made up mainly of wheat, lead, oats, pork, hides, corn, flour and livestock. This railroad had a considerable influence on the development of already existing towns such as Mineral Point, Darlington and Gratiot. Mineral Point had the advantage of being the only large mining center with a railroad for nearly fifteen years. Thus, the railroad undoubtedly contributed much to the renewed mining activity in the Mineral Point area, especially the mining and smelting of zinc. It was responsible in large part for the prosperity of the city and its dominance over the mineral district until the late 1880's, when Mineral Point lost its population leadership to Platteville.

The Mineral Point Railroad was built to serve the mining region; transportation of zinc played a prominent role in its success. In 1869 some 4,390 tons of zinc ores, valued at $57,000, were moved over the line, principally to supply the furnaces at La Salle, Illinois. An additional

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[149] Ibid., p. 288.

2,000 tons, probably from the extreme southern part of the Wisconsin district, were shipped in the same year over the Illinois Central Railroad. The Mineral Point zinc works (Phelps-Dodge) also exported 1,317,380 pounds of zinc oxide over the railroad. At eight cents per pound this was valued at $105,389.[150]

Although the closing of the zinc works in Mineral Point was a heavy blow, the city still retained its mining prominence due to the presence of the railroad. In 1872 "the zinc ore streams that passed in each day were astonishing. On Thursday Mr. Mueller brought 200 tons, on Friday about the same, on Saturday over 300 tons. . . ."[151] By 1874 it was said that "150 to 200 teams have been seen in that city /Mineral Point/ daily delivering ore at the railroad depot to be shipped to Illinois, near the coal fields, there to be manufactured."[152] Table 2 shows the total freight shipped over the railroad in 1874 and indicates the relative importance of zinc.

TABLE 2

FREIGHT SHIPPED ON THE MINERAL POINT RAILROAD, 1874
(Source: Grant County Witness, January 28, 1875, p. 3.)
In pounds unless otherwise stated

Merchandise	12,000,000	Oats	19,000,000
Lead	3,000,000	Corn	163,000
Potatoes	1,800,000	Flax seed	5,000,000
Powder	404,000	Rye and barley	2,500,000
Agricultural Implements	820,000	Zinc ore	24,200,000
		Salt	4,500 barrels

[150]"Report of the Assembly Committee on Mining and Smelting," Grant County Witness, March 18, 1870, p. 1.

[151]History and Guide to Mineral Point, op. cit., p. 190.

[152]Transactions of the State Agricultural Society, XII, 1873-1874 (Madison: Atwood and Culver, 1875).

TABLE 2--*Continued*

Butter, eggs	812,000	Flour	3,000 barrels
Wool	99,000	Coal	3,000 tons
Hides	828,000	Laths and Shingles	1,000
Stone and brick	520,000	Lumber	4,000,000 feet
Hoop poles	326,000	Cattle	5,700 head
Wheat	21,000,000	Hogs	35,000 head
		Dressed hogs	933,000

In early 1876 the railroad was moving an average of five cars of zinc ore per day on a year round basis from Mineral Point.[153] With the opening of the new zinc works in Mineral Point in 1882, ore found its way to the city for processing as well as for export, and once again zinc oxide was a product shipped out of southwest Wisconsin over the Mineral Point railroad.

Dubuque, Platteville, Milwaukee Railroad

Platteville, the major city and mining center of Grant County, was without a rail connection until 1870. Even so, it had gained in population after the decline of lead mining because of its acquiring a normal school and its expanding function as an agricultural center. Serious agitation for a railroad began there in 1860. Railroad meetings were held,[154] and a route to connect Platteville with the Mineral Point Railroad at Calamine was suggested. On March 15, 1861 the Platteville and Calamine Railroad Company was incorporated; later in that year the company became the property of the Mineral Point Railroad Company.[155]

[153] *Grant County Witness*, March 2, 1876, p. 2.

[154] *Ibid.*, January 26, 1860.

[155] Derleth, *op. cit.*, p. 288.

The project was delayed by the Civil War but was taken up again in 1867, at which time it became known as the Dubuque, Platteville and Milwaukee Railroad Company.[156]

As was true for many railroads of the time, capital for the Platteville to Calamine route was in short supply. It appeared that construction of the line would have to depend upon monetary support from its future customers. In 1867 a noted Platteville legislator, Hammer Robbins, introduced a bill in the Legislature to allow the citizens of several townships along the proposed route to vote aid for the railroad. The law was passed and people of Platteville, Elk Grove and Kendall Townships subscribed for $270,000 of stock in the road. Not only did the citizens support the contemplated railroad financially, but 113 Grant County men participated in a grading bee to aid in its early construction.[157] By July 1, 1870 the Dubuque, Platteville and Milwaukee Railroad had completed the seventeen miles of track between Platteville and Calamine, via Belmont.[158] The line was of particular significance to the mining interests of the Platteville area for it made possible cheap and rapid transportation of the ores to the smelters in Illinois and Mineral Point (after 1882). Strong, in 1877, mentions Platteville as being one of the chief ore shippers in Wisconsin. That the mineral industry was important in providing freight to this railroad is shown by the amount of zinc, as compared to other products, being shipped shortly after the line opened (Table 3).

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[156] Ibid.

[157] Castello N. Holford, History of Grant County, Wisconsin (Lancaster, Wisconsin: The Teller Print, 1900), p. 476.

[158] Derleth, op. cit., p. 288.

TABLE 3

FREIGHT SHIPPED ON PLATTEVILLE-BELMONT RAILROAD,
NOVEMBER 1870-MARCH 1871
(Source: Grant County Witness, December 22, 1870;
January 5, 1871; April 14, 1871.)

	November	December	January	February	March
Sheep	-	95 head	-	-	-
Hogs	20 cars	3,310 head	13 cars	5 cars	-
Cattle	14 "	223 "	4 "	13 "	8 cars
*Zinc ore	16 "	24 cars	27 "	19 "	13 "
Miscellaneous	8 "	6 "	6 "	5 "	15 "
Powder	1 "	4 "	1 "	-	1 "
Hoop poles	-	10 "	17 "	5 "	2 "
Dressed hogs	-	4 "	7 "	-	4 "
Flour	-	-	3 "	-	1 "
Lead	-	-	1 "	3 "	4 "
Grain	-	-	1 "	6 "	3 "
Potatoes	-	-	1 "	1 "	2 "
Carriages	-	-	-	-	2 "

Galena and Southern Wisconsin Railroad

The third railroad of significance to the mining region was begun when the Galena and Southern Wisconsin Railroad was incorporated in 1858. This railroad was to have been a great boon to mining, but nothing came of the venture until 1871, when a route was finally surveyed.[159] The route was to connect Galena, Illinois and Fennimore, Wisconsin, via Platteville. To aid in its completion Platteville voted $32,000 in bonds for use by the railroad.[160] Other towns along the route did likewise.

Official notice was given to this railroad's construction, when Governor C. L. Washburn, in his message to the State in 1873, said:

[159] Holford, op. cit., p. 476.

[160] Ibid.

"A narrow gauge railroad is being constructed from Galena to Platteville and Lancaster in Grant County, and will be in operation next summer, and will no doubt be of great benefit to the farmers of that section of the state."[161]

Although agriculture certainly was to be served by the road, mining interests too were quick to see the advantages of its being built. In February, 1873, a delegation of men from Mifflin requested that the Board of Directors of the Galena and Southern Wisconsin Railroad consider having the road pass through Mifflin instead of two miles west as proposed. The town offered to tax itself in order to help attract the railroad to it. The committee members claimed that if the line was routed through their town, it would secure a considerably larger volume of freight because it would pass close to several rich mines.[162] Their proposal was ignored, however, and the route followed was as originally planned - west of Mifflin.

By January 1875 the narrow gauge line was completed north as far as Platteville, but was so poorly constructed that much track had to be re-laid.[163] The railroad's total length that year was thirty-one miles, twenty of which were in Wisconsin. Extension of the line north to Wingville (Montfort) came later.

A city that benefitted considerably from the new line was Benton. Prior to the railroad's opening, farmers, merchants, and miners there were forced to use wagons to haul their goods to and from the outside world. "The completion of this enterprise made a material difference in the

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[161] Grant County Witness, January 23, 1873.

[162] Ibid., February 13, 1873.

[163] Holford, op. cit., p. 477.

town's business and prosperity."[164] Though not a large shipper of zinc in the early days of the railroad, Benton became one of the major exporters of ore in the district after several large strikes were made in the 1880's. In fact, one source in 1877 called it the leading zinc shipper in southwest Wisconsin.[165] Great quantities of zinc ore and an associated product, sulphur, were being shipped from Benton to St. Louis, Mineral Point, Peru, and La Salle.[166]

Situated on the new railroad, and born as a direct result of it, was the village of Cuba City, at first called Yuba City. By June of 1875 it was already shipping black jack, as well as oats and other freight.[167]

In 1879 the narrow gauge extension from Platteville to Wingville was being built.[168] Though not directly benefitting Mifflin, as mentioned above, the chosen route did influence the development of Livingston. Mr. Livingston had purchased the land on which the town that bears his name now stands in 1860. He donated some of this to the railroad, and the town became a place on the route between Platteville and Wingville. Livingston was platted in 1880 and by the end of the year had twenty-nine residents. The town of Rewey was also founded as a result of the coming of the railroad and, like Livingston, shipped some of the Mifflin ore.

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[164] Lafayette County History, op. cit., p. 557.

[165] "In the Lead Region," op. cit., May 28, 1887.

[166] Shipments from Benton in 1886 were 4,556,600 pounds of zinc ore, and 1,200,000 pounds of sulphur, according to "In the Lead Region," The Miner and Manufacturer, May 21, 1887, p. 2.

[167] Grant County Witness, June 17, 1875, p. 3.

[168] Holford, op. cit., p. 72.

Other railroads

One other important mining town had a rail connection before 1895. This was Shullsburg, which had tried to secure a railroad as early as 1850. It finally succeeded when the Chicago, Milwaukee and St. Paul Railroad, after reaching Gratiot in 1881, was completed to the city. In 1886 Shullsburg shipped by rail: drybone, 1,012,630 pounds; jack, 418,600 pounds; and sulphur, 347,800 pounds. The drybone went to St. Louis, the jack to Mineral Point and La Salle, and the sulphur to Nashville, Tennessee.[169] The sulphur was made into sulphuric acid, and the refuse sold as fertilizer.[170]

The Chicago and Northwestern connecting Madison, Dodgeville, Cobb, Wingville, and Fennimore, was another area railroad completed before 1895. It, however, skirted the northern edge of the district and was less important to the zinc industry than the other lines mentioned above. The same was also true of the Chicago, Burlington and Quincy Railroad which followed the Mississippi River.

Undoubtedly the railroads of the mining region were quite successful financially - much more so than the Milwaukee or Chicago interests, which had by-passed southwest Wisconsin, ever thought possible. Thus, it is not surprising that in 1880 the larger and wealthier Chicago and Milwaukee based railroad interests bought out the smaller railroads of southwest Wisconsin. The Chicago and Northwestern Railroad Company acquired the Galena and Southern Wisconsin Railroad in April, 1880. The line was to be extended northward to Montfort and Highland, and then eastward to Dodgeville and

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[169]"In the Lead Region," op. cit., May 14, 1887, p. 5.

[170]Ibid., March 26, 1887, p. 4.

Madison.[171] The same company also purchased the narrow gauge line from Lancaster to Woodman, in northwestern Grant County, which had been completed in January, 1879.[172] In July and August, 1880, the Mineral Point Railroad Company deeded the Calamine-Belmont, and the Belmont-Platteville lines to the Chicago, Milwaukee and St. Paul Railroad Company.[173]

Summary

By 1895 zinc mining was definitely well established in southwest Wisconsin. Although mining would never again play the dominant economic role it had in the early history of the Lead Region, it still was an activity of significance. The period 1860 to 1895 had seen many changes in the mining industry. Undoubtedly the greatest of these was the complete turnabout in what the miners were seeking. That is from the major objective of lead, with zinc at best only an incidental by-product in 1860, to the major objective of zinc with lead being incidental by 1895. The several geological and mining surveys made the area much better known and Chamberlin's pro-zinc announcement in the Geology of Wisconsin studies gave much hope for the future of the area. His attitude that abundant zinc existed deeper than then current levels was a stimulating factor in the development of zinc mining. The possibility of ores at greater depths brought in more capital. The increased capital allowed the beginning of a slow, but sure, moderniza-tion of mining, deeper than ever before. To be certain this was still

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[171] Grant County Witness, April 29, 1880.

[172] Holford, op. cit., p. 72.

[173] Derleth, op. cit., p. 288.

not deep mining in the strict sense of the word, but ores at lower levels than before were being exploited allowing zinc production to grow continually larger. The Lead Region in general and the mining industry in particular benefitted from the spread of railroads between 1860 and 1895. Most of the major mining centers were also railroad stations, or were within a short distance of a station. Last, but far from least, was establishment of the zinc works in Mineral Point. Though short lived, the first zinc smelter of any significance (Phelps-Dodge) gave zinc mining needed impetus when it was in its infancy. The Mineral Point zinc works, which began in 1882, brought a much needed local market for zinc ore and was a significant contributor to the development of the zinc industry in the Lead Region and to the economic prosperity of Mineral Point.

CHAPTER III

THE PROSPEROUS YEARS, 1896 - 1920

Considerable progress had been made in southwest Wisconsin toward the development of a significant zinc industry in the period 1860-1895, and the region's mines produced considerable quantities of drybone, blackjack and lead. In the early 1890's, however, the zinc industry here was small and primitive by national standards, and not on a sound financial basis. Some companies had attempted to mine on a more modern basis but various problems were encountered - diminishing quantities of high quality ore, inability to profitably separate the blende and marcasite, insufficient capital reserves - to mention a few; these coupled with the financial panic of the early 1890's closed numerous mines. There were many unemployed miners and several of the mining camps presented "sorry spectacles with store buildings and homes empty"[1] at the beginning of the period under study.

The situation changed rapidly and for the better, bringing to southwest Wisconsin one of the most colorful, exciting and prosperous periods in its history. As demand for zinc rose significantly, prices paid for it on the national and local levels markedly increased bringing about more careful study of the zinc resource of the region and subsequent widespread development of mining properties. Prices and production

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[1]A. J. Roethe, "The Lead and Zinc Fields of Wisconsin," Engineering and Mining Journal, LXI (1896), p. 88.

continued to climb, being aided by the demands of World War I, until the end of the period.

The prosperous zinc industry of the region that evolved between 1896 and 1920 was quite different in several basic ways from the one just examined during 1860-1895. In fact, although increased demand and rising prices were significant in the resurgence of the region's zinc industry, they alone were not responsible. Those factors, in association with changes in mining and processing methods, made the rejuvenation possible. After 1900 a major change took place in the mining industry of southwest Wisconsin - deeper mining resulting in a shift from selective to non-selective methods. There were two chief characteristics in this change: (1) a decline in the ore grade accompanied by an increase in the amount of ore mined, and (2) an innovation in techniques of ore concentration. The first resulted in the beginning of large scale mine mechanization which was necessary to produce the large tonnages at low cost. The second was the development of a satisfactory concentrating method, roasting and magnetic separation, that allowed leaner ores to be mined and higher metal content concentrates to be produced.

The mining and processing changes were interrelated and they also were intricately connected with the changes that took place in the industry's organizational pattern. In the previous periods one man operations, partnerships or small companies were the most common organizational forms. A major change came in the early 1900's when hundreds of stock companies were formed with many shareholders, boards of directors, and tens of employees. This type of establishment was necessary because more capital was needed than in previous decades to undertake the deeper and costlier mining of the new century. It was not the final corporate firm to be seen in the area however, for most of these companies, too, were unable to stay solvent in an ever more costly endeavor. Thus during the period under study the area fell under the domination of subsidiary companies of large national concerns.

Another major change during the period involved the miners and their settlements. Together with the industry's prosperity came problems, one of which was labor shortages. To cope with this problem several of the large zinc companies encouraged mine workers and laborers to come from other regions - foreign countries as well as other states. These immigrants brought a unique aspect to the cultural landscape of southwest Wisconsin, and some remnants of their occupance - both physical and cultural - remain today.

Price and Production Trends

Between 1896 and 1920 market conditions for zinc were vastly improved. Demand for zinc increased, thus pushing prices for it upward. Mining men in southwest Wisconsin began to increase their activity in order to take advantage of the good market for zinc. As a result production increased and the area experienced one of the most prosperous and exciting periods in its history.

Increasing demand

In the late 1890's the demand for zinc began to increase; its uses were many and varied. There was a continuing large consumption of zinc oxide by the paint industry to produce white pigment. Also the rubber industry mixed zinc white with gum to manufacture numerous articles, including slickers used by miners. Rolled, sheet zinc was

utilized architecturally in building and for roofing; ornamental room ceilings and walls, moldings, friezes were stamped from rolled zinc. The plumbing and electrical industries used large amounts of zinc and much melted spelter was used to galvanize iron. The most significant use of zinc, however, during the period was alloying it with copper to form brass. While most uses of zinc grew after 1895, the manufacture of brass had phenomenal growth.[2]

Rising prices

On the national scene the price of zinc metal dropped to an all time low yearly average - three and one half cents per pound in 1894. As demand for zinc increased the price of zinc also began to climb - to over four cents per pound in 1897, over five cents in 1903, and over six cents in 1906 (Figure 9). This national spelter price was of course reflected in the amount paid for local ores. Jack seldom brought more than $18 per ton in the early 1890's,[3] but the average value of standard quality ore in 1897 was $22.28 per ton and in 1898 it was $28.44.[4] During the winter of 1900, because of a strong foreign market, the local price for ore went up to $55 per short ton![5] The average price soon dropped back to $33 per short ton, but the general upward trend continued.[6]

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[2]Harold Barger and Sam H. Schurr, The Mining Industries, 1899-1939 (New York: National Bureau of Economic Research, 1944), p. 37.

[3]Tri-State Yearbook of Wisconsin, Illinois and Iowa Lead and Zinc Mines (2nd. ed.; Cuba City, Wisconsin: Meloy and Brewer, 1907), p. 37.

[4]"History and Guide to Mineral Point," (manuscript) WPA Federal Writers Project, c. 1941.

[5]Tri-State Yearbook . . ., op. cit., p. 37.

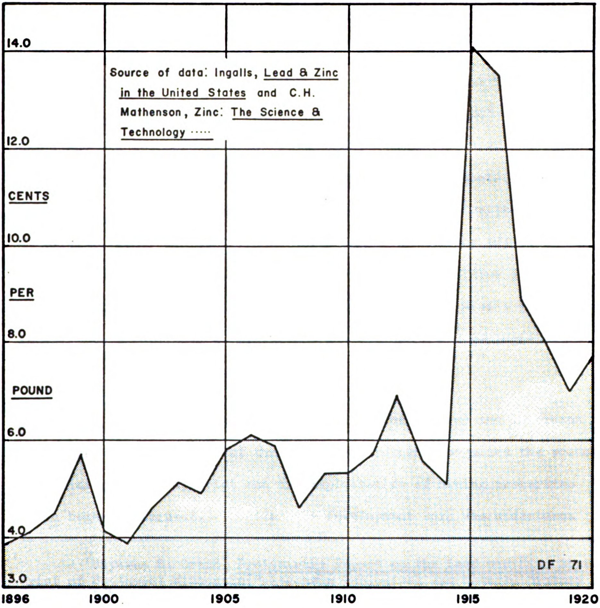

FIGURE 9. Average Annual Price of Prime Western Slab Zinc, 1896-1920

Studies of the region

Renewed official interest in southwest Wisconsin's zinc resources followed improved national zinc market conditions. The Wisconsin State Geological Survey in 1900 directed Northwestern University's Professor Ulysses S. Grant to study the region. He was to outline the current and future possibilities for mining zinc and lead in southwest Wisconsin. Grant published informative and encouraging reports in 1903 and 1906.[7] The Wisconsin Geological Survey's own staff studied the area and outlined the results in its Fourth[8] and Sixth[9] Biennial Reports. Also, a detailed study of the mining region and its mines was written by H. F. Bain, Director of the Illinois State Geological Survey and published jointly by the Wisconsin Geological Survey and United States Geological Survey in 1907. Later, additional examinations of the area's mining industry were published by mining company engineers and geologists.

Expanding zinc production

With the continuing advance in the price of zinc and increased knowledge, the mining men of the Tri-County region recognized the economic potential of their district and the exploitation of mining properties again began in earnest. Considerable development work was undertaken

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[7]Ulysses S. Grant, Preliminary Report on the Lead and Zinc District of Southwest Wisconsin ("Wisconsin Geological and Natural History Survey," Bull. no. IX; Madison, Wis.: State of Wisconsin, 1903); and Report of the Lead and Zinc Deposits of Wisconsin ("Wisconsin Geological and Natural History Survey," Bull. no. XIV; Madison, Wis.: State of Wisconsin, 1906).

[8]Fourth Biennial Report of the Commissioners of the Geological and Natural History Survey, 1904 (Madison, Wis.: State of Wisconsin, 1905).

[9]Sixth Biennial Report of the Commissioners of the Geological and Natural History Survey, 1906-08 (Madison, Wis.: State of Wisconsin, 1909).

between 1900 and 1904, but no significant increase in production was noted (Figure 10). From 1904 to 1905 production nearly doubled from 6,755 short tons of zinc metal to 11,441 short tons and the boom was on. A new era of mining prosperity had begun for southwest Wisconsin. Hundreds of mines and/or mining companies were established and from 400[10] to 1000[11] prospect drill rigs were estimated to be in operation during one period. Between 1903 and 1907 the region experienced the greatest amount of mining activity it has ever known. Local newspapers were filled with information on mining matters, ranging from descriptions of mining techniques and production data, to mining company prospectuses and tips to mining stock investors. As evidence of the importance of the mineral resource, one of the area's leading newspapers, the Grant County Witness, changed its name to the Platteville Witness and Mining Times, and the words LEAD AND ZINC were placed in bold letters under the new name.

The mining industry of the region became internationally famous. In the weekly periodical Mining World news from southwest Wisconsin was a regular feature in the section entitled "Mining News from Busy Mining Camps." Numerous treatises on zinc or the national/international zinc industry included information about the area. In a standard work describing the zinc industry, Ingalls in 1908 stated that "at the present time, it [Wisconsin] is considered to have a bright future as a source of zinc ore."[12] Indeed Wisconsin between 1903 and 1920 never ranked

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[10] U. S. Geological Survey, Mineral Resources of the United States, 1906 (Washington: Government Printing Office), p. 473.

[11] Tri-State Yearbook . . ., op. cit., p. 37.

[12] W. R. Ingalls, Lead and Zinc in the United States (New York: Hill Publishing Co., 1908), p. 138.

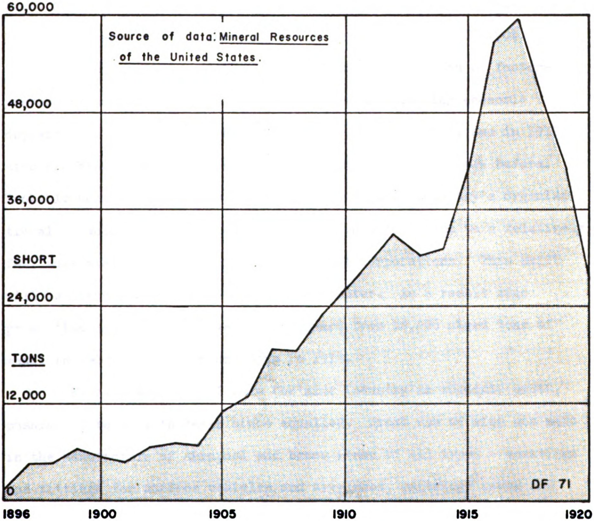

FIGURE 10. Wisconsin Zinc Metal Production, 1896-1920

lower than fifth among the states in zinc production, usually ranked fourth, and in 1908 was third.

This early boom did not last long however. Injudicious expenditures of capital on shaft sinking, machinery, and erection of buildings on properties which proved to be worthless, together with the financial panic of 1907 with an accompanying decline in zinc prices, brought an end to the boom era,[13] and a leveling off of production in 1907-1908.

Fortunately for southwest Wisconsin a combination of factors prevented the industry from slipping into a long lasting economic depression. In 1909, a recovery was noted in zinc prices and in 1912 zinc ore brought $65 per ton,[14] higher than it had ever been before. Probably more important was the shift in the local industry's organizational structure from many small locally owned companies to a relatively few, subsidiary companies of large national corporations. This shift will be discussed fully, later in this chapter. As a result zinc production continued to move slowly upward from 18,206 short tons of metal in 1908 to 31,113 short tons in 1914.

Finally World War I gave the zinc industry an economic boost, pushing it to heights never since equalled. Great use of zinc was made in the manufacture of shrapnel and brass items of all types - mountings and fittings for surface vehicles and airplanes, cartridge cases and arms. Prices skyrocketed and production followed. Nationally the average annual price for prime western slab zinc rose to over fourteen cents per pound in 1915 (from five and one tenth cents per pound in 1914), the

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[13] The Miner, Yearbook of the Wisconsin State Mining School, I (Platteville, Wisconsin: 1915).

[14] Platteville Witness and Mining Times, June 24, 1912.

highest price ever paid for zinc metal in terms of monetary purchasing power. Locally some zinc ore was being sold for as much as $114 per ton in 1916![15] Following the rapid increase in price was a comparable rise in production. Zinc output spectacularly jumped from 31,113 short tons of metal in 1914 to 41,403 short tons in 1915 and then steadily rose to an all time Wisconsin high of 59,742 short tons in 1917. From this peak, production dropped fairly rapidly during the next three years and at the end of the period production was on a downward trend.

Location of Mining

Although a new era of mining had dawned upon southwest Wisconsin there was little shifting in the location of the industry. The outer boundaries of the district, which had been delineated many decades before, were not extended. The large "barren" areas within the district, which had existed for many years were not mined in the period either. The old locational pattern of mines grouped into districts and subdistricts with the large, unworked "barren" areas in between remained the same between 1896 and 1920. The main change from the previous study period was the emergence of the southern mining fields as southwest Wisconsin's major producers (Map 12).

The continuing locational pattern was the result of the fact that during the prosperous years almost all mining was done by working deeper or extending the workings of the old ranges, long ago established. In fact with relatively few exceptions, the same camps which had been associated with past mining activity were important in the new era. In

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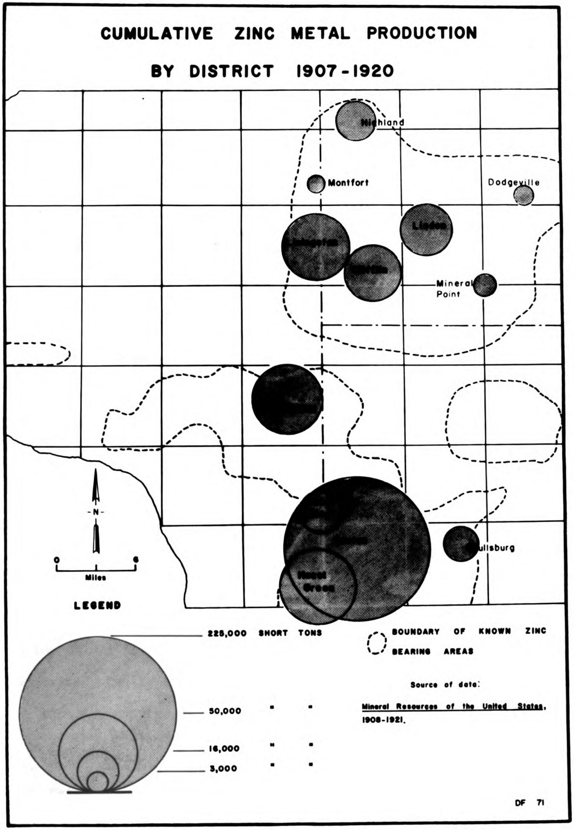
[15] Ibid., February 9, 1916.


CUMULATIVE ZINC METAL PRODUCTION
BY DISTRICT 1907-1920
Montfort
Dodgeville
Mineral Point
N
0
6
Miles
LEGEND
225,000 SHORT TONS
50,000 " "
16,000 " "
3,000 " "
BOUNDARY OF KNOWN ZINC BEARING AREAS
Source of data:
Mineral Resources of the United States, 1908-1921.
DF 71

MAP-12

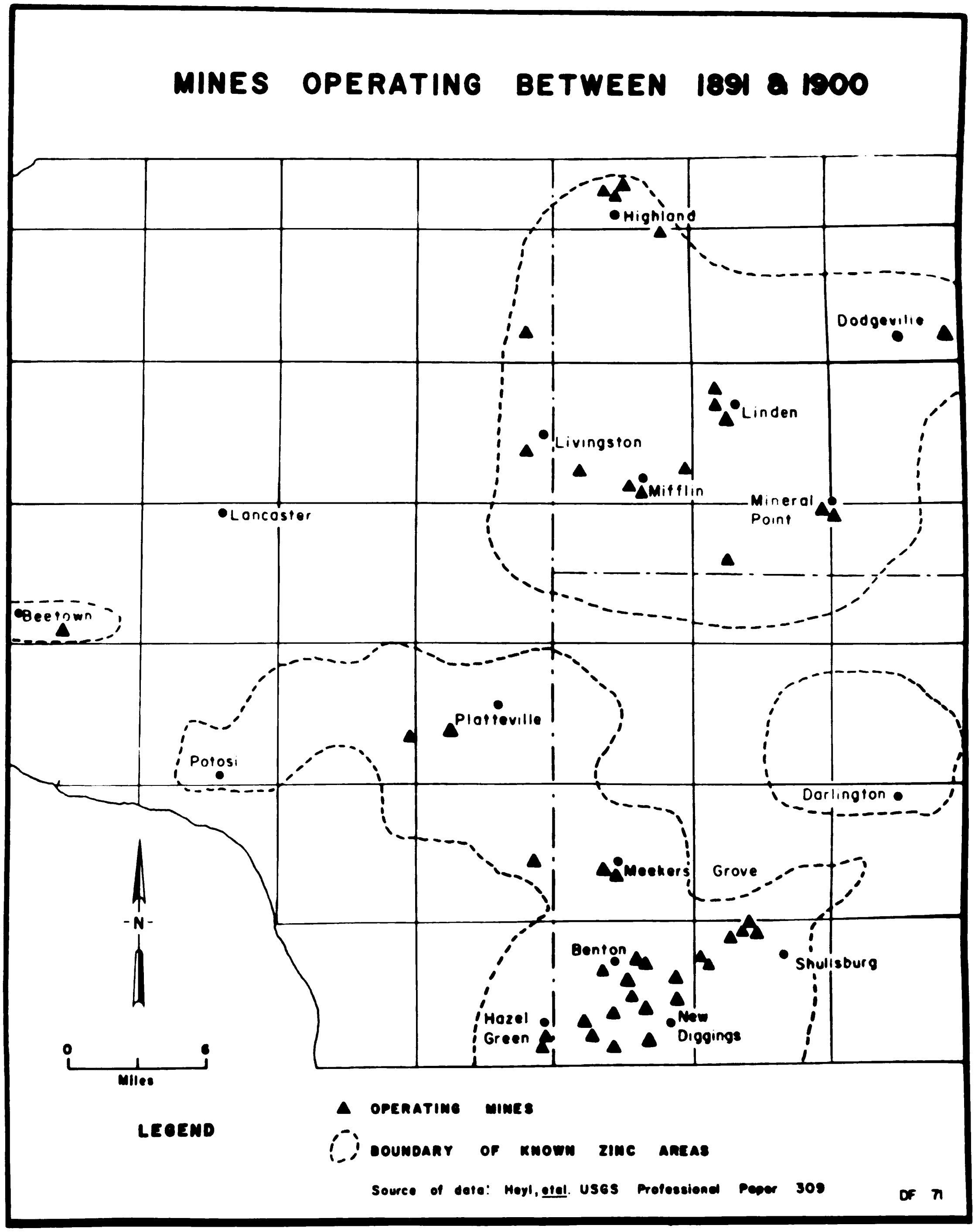
the southern part of the region important centers of mining were Benton, New Diggings, Shullsburg, Hazel Green and Meekers Grove. This was an important area throughout the period under study as evidenced by the large number of operating mines (Maps 13, 14 and 15) and the large production.

The Platteville area was especially important between 1900 and 1920. It was the success of the Enterprise and Empire mines in Platteville between 1900 and 1905 that gave the impetus to the boom which brought great wealth to the Tri-County region. Many workings were profitably developed in and around Platteville through 1910. After 1910, although some profitable mining continued in the vicinity, the city retained its mining significance because several of the larger mining companies had their headquarters there.

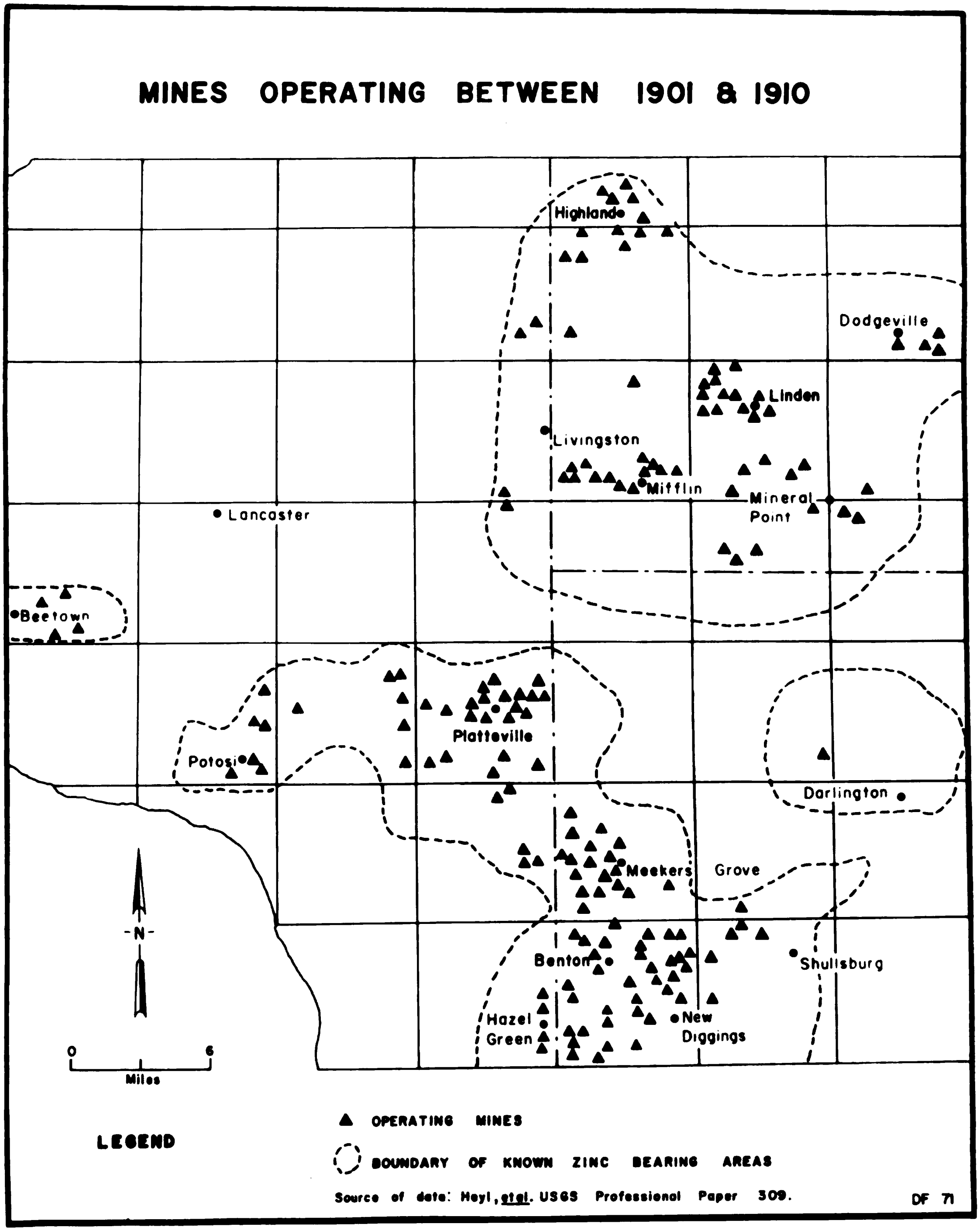
In the northern part of the region were the mining centers of Highland, Montfort, Livingston, Mifflin, Linden and Mineral Point. Like the southern camps these too were longtime producers, but mining activity began to increase tremendously after 1910 (See accompanying maps) and unlike Platteville, continued to develop at a high level through 1920. Of the northern camps, Highland, noted for its drybone, Livingston, Mifflin and Linden were most active and productive. Mineral Point, which for a long time had dominated the local mining scene, maintained its importance in the zinc industry not because of its mining but because of the zinc and acid works in the city.

Organizational Character of the Industry

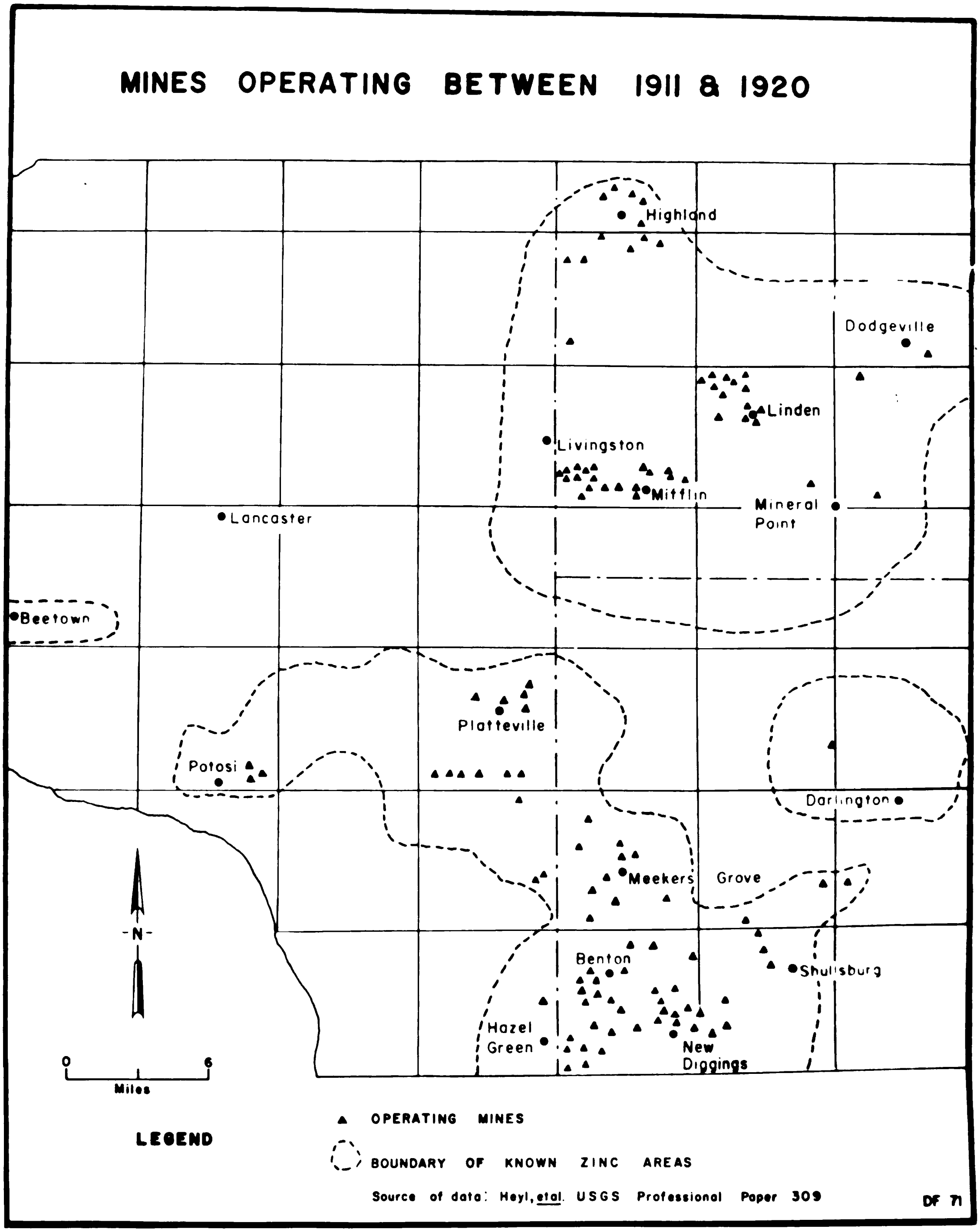
Until the turn of the century successful properties had been worked mainly by individuals, partnerships or small companies, but without the formality or need of incorporation. As the character of


MINES OPERATING BETWEEN 1891 & 1900
Highland
Dodgeville
Linden
Livingston
Mifflin
Mineral Point
Lancaster
Beetown
Platteville
Potosi
Darlington
Meekers Grove
Benton
Shullsburg
Hazel Green
New Diggings
N
0 6
Miles
LEGEND
OPERATING MINES
BOUNDARY OF KNOWN ZINC AREAS
Source of data: Heyl, etal. USGS Professional Paper 309
DF 71

MAP-13


MINES OPERATING BETWEEN 1901 & 1910
Highlands
Dodgeville
Linden
Livingston
Mifflin
Mineral Point
Lancaster
Beetown
Platteville
Potosi
Darlington
Meekers Grove
Benton
Shullsburg
Hazel Green
New Diggings
N
0 6
Miles
LEGEND
OPERATING MINES
BOUNDARY OF KNOWN ZINC BEARING AREAS
Source of data: Heyl, etal. USGS Professional Paper 309.
DF 71

MAP-14


MINES OPERATING BETWEEN 1911 & 1920
Highland
Dodgeville
Linden
Livingston
Mifflin
Mineral Point
Lancaster
Beetown
Platteville
Potosi
Darlington
Meekers Grove
Benton
Shullsburg
Hazel Green
New Diggings
N
0 6
Miles
LEGEND
OPERATING MINES
BOUNDARY OF KNOWN ZINC AREAS
Source of data: Heyl, etal. USGS Professional Paper 309
DF 71

MAP-15

mining changed in the early 1900's because of the exhaustion of rich shallow ores, so too did the organizational character of the mining industry change.

Formation of corporations

After the need for deeper mining and more complex processing was established, most mines were developed by corporations. There were two main reasons for such an organizational pattern. First, and foremost, there were few men, individually or even in groups of twos or threes, who had sufficient capital to undertake a "modern" mining operation. Secondly, it was a form of insurance. The mining companies did not have insurance in the early boom period and a small company, drawing upon the assets of only a few individuals, might have been ruined financially if an injured worker could prove negligence on the part of the company.[16]

A few mining groups had enough wealthy members that the firm could be kept as a closed company, however most organizations needed capital and vigorously sought to sell shares to the public in their establishment. Stock selling and corporation development were especially active during the years 1904-1908. Stock brokerage offices were established, such as the Dubuque Lead and Zinc Exchange, the Platteville Lead and Zinc Exchange, and the W. C. Forehand Mining Investment Firm, to name only a few, and several men became broker's agents. The newspapers regularly carried articles describing a mining company just formed and told of its prospects. These articles (sometimes they were paid advertisements) usually indicated that stock in the mine was for sale. Stocks

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[16]Personal interview with Mr. A. W. Kopp, retired congressman, federal judge and mine owner, Platteville, Wisconsin. February 19, 1966.

were usually non-assessable and had low values; $1 per share was common.

Optimism was high in the early 1900's; even local children would save pennies to buy stock in mining companies. Many local people invested in the developing mines, but large amounts of capital were coming into southwest Wisconsin from distant investors. Montgomery Ward of Chicago bought mining property, the Parker brothers (of Parker Pen fame) from Janesville, Wisconsin purchased large blocs of stock, and it was rumored that William Randolph Hearst was becoming interested in local area mines.[17]

Usually a company would not be formed unless the organizers had a good idea as to where ore could be found. If they had this knowledge they would organize by applying for a charter, filling subscription papers and then sell stock to raise the needed capital. When sufficient capital had been raised the stockholders would meet, elect a board of directors and appoint or hire a mine superintendent. Then the company would go mining, and the first formal step was to obtain mineral rights to the land on which they hoped to find ore.

Obtaining mining rights

Verbal agreements only were common between miners and landowners before 1900. The situation changed, however as the boom in mining began, from verbal to written agreements. A local newspaper reported a case which gives evidence of this change. A miner, working on the basis of a verbal agreement, was kicked off the property during his tenth year of mining it. He took the case to court, but the verdict was in favor of the landowner. The paper editorialized that "this settles the proposition that no one will hereafter work upon lands for mineral

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[17] Platteville Witness and Mining Times, May 30, 1906.

without a written lease."[18]

Leasing of land.--Although some mining concerns did purchase land outright, because of the relatively short life of the mining ground, leasing was by far the most common system. The common situation was for the land owner to lease his land with mineral rights, to the mining company for a flat royalty per ton of ore mined. The usual first royalty was 10% but ranged from 7½-12%, with the higher royalties being paid in the dry mines where expenses would be lower.[19] Nearly all leases were perpetual, i.e., in effect from the time the instrument was executed until work was discontinued. Leases were easy to obtain in rural areas, however mining companies often had difficulty securing mining rights in the cities. Still some of the smaller towns such as Mifflin, and even the larger ones including Platteville, had mines inside city limits in residential areas.

It was pointed out by the Wisconsin Conservation Commission in 1911 that the leasing system often brought about the wasting of part of the mineral resource. This resulted from the practice by some mining companies of taking only the highest quality ore from the ground; since they would have to pay the same royalty on each ton of ore mined, regardless of its quality.[20]

Purchasing land.--Those companies that desired to purchase land for mining could do so in the early 1900's for $1.25 to $3.50 per acre in

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[18] Grant County Witness, March 18, 1903.

[19] H. F. Bain, Zinc and Lead Deposits of the Upper Mississippi Valley ("Wisconsin Geological and Natural History Survey," Bull. no. XIX; Washington: Government Printing Office, 1907), p. 146.

[20] James A. Lake, Law and the Mineral Wealth of Wisconsin (Madison, Wisconsin: University of Wisconsin Press, 1962), p. 164.

rural areas. By comparison, in the Joplin district at the same time, mineral lands were selling for $500-600 per acre. The large difference in price was due to the much greater thickness of the ore deposits in Missouri, resulting in a higher potential production there. By the end of World War I good mineral lands in Wisconsin were commanding $10-20 per acre, on the average, although in some extreme cases brought over $1000 per acre.[21]

The working small corporation

After the land was secured either by lease or purchase, prospecting would begin. If exploratory work showed no or insufficient ore deposits, and funds remained, the company might try in a different location or else dissolve the corporation.

If ore was struck in paying quantity and quality the superintendent was directed to assemble a crew to construct the initial buildings - an engine (power) house and a shaft house. Then a crew of five or six were hired to sink the shaft. Water could be expected anywhere between 30 and 100 feet - thus an essential purchase - pumps - would soon be necessary. After the shaft reached the ore deposit drifting would begin and by this time the work force would be around fifteen men. Finally, once the ore was being hoisted to the surface a processing mill would have to be put in operation.

The business end of the operation was usually handled by a few persons. The officers, president and secretary, and/or a committee of the board of directors would take care of all clerical details, purchase equipment, sell ore and perform other necessary administrative tasks.

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[21] "History and Guide to Mineral Point," op. cit., p. 261.

Many of the leaders of southwest Wisconsin served as officers in one or more mining companies.

Each company would normally work only one mine. When its mine became exhausted the company looked for a new location; if such could not be found, the company was dissolved. The average life of a mine in southwest Wisconsin during the boom period was about three years. Frequently when a company stopped operating its mine it would be subleased to employees to work in their spare time. Sometimes the employees were able to make new strikes and experience a profit for their endeavors.

Such was the common organizational pattern of the industry in the early 1900's; many small companies, mostly corporations of local origin predominated. Between 1904 and 1907 at least 207 mining companies were incorporated in southwest Wisconsin.[22] Although there were fraudulent dealings and much money was undoubtedly lost in speculative schemes, still the creation of stock companies greatly aided the region's development.

Shift to the large, national corporations

From over 200 companies in the district in 1907 the number dropped to 88 in 1909.[23] The trend toward control of the region by large companies had begun. This shift away from the many small companies in the early boom years, to the few large corporations after 1910 was one of the most significant characteristics of the period under study. This shift came about almost entirely as a result of the increasingly large amounts of capital needed to conduct a successful mining operation. New and improved methods of mining and processing the ore required larger

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[22] Tri-State Yearbook . . ., op. cit.

[23] "History and Guide to Mineral Point," op. cit., p. 257.

investments in equipment and skilled labor than many small companies were able or willing to make.

The major companies.--The large corporations which soon controlled most of the district were few in number to begin with and their number became even smaller as time passed. Shortly after 1910 there were seven major companies in the region: Mineral Point Zinc Company, Vinegar Hill Zinc Company, Wisconsin Zinc Company, Cleveland Mining Company, Frontier Mining Company, Field Mining and Milling Company, and the Optimo Mining Company. In 1913 these seven companies mined 44% of all lead and 77% of all zinc concentrates shipped from the district.[24] By 1914 their combined share had grown to 61% of the lead and 85% of the zinc. As time passed the Cleveland, Field, and Optimo companies became insignificant producers or dropped out of the field entirely. Thus by 1920 the four remaining major companies, Vinegar Hill, Mineral Point, Wisconsin and Frontier, produced 60% of the lead and 77% of the zinc concentrate shipped from Wisconsin.[25]

The Mineral Point, Vinegar Hill, and Wisconsin zinc companies had affiliations with major national corporations. Therefore they were able to accomplish in the district what many of the small independent companies could not, namely, ride the crests and depressions of the zinc mining industry and still remain sound.

The Mineral Point Zinc Company was the eldest of the three, having been founded in the nineteenth century. In 1897 it became an affiliate of the strong, nationally prominent New Jersey Zinc Company and began a

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[24] Ibid., p. 258.

[25] U. S. Geological Survey, Mineral Resources of the U. S., op. cit., 1920, p. 149.

program of expansion in the region. The subsidiary and parent companies both bought and leased mining lands, primarily in the northern part of the district. One of the Mineral Point Zinc Company's most renowned purchases, taking place in 1907, was the Ellsworth farm north of Rewey on which were located the famous Coker mines. Another major area of land acquisition was in the Highland region, the district's chief supplier of drybone. Most of the drybone went to the Company's oxide plant at Mineral Point. By 1919 the New Jersey Zinc Company and/or the Mineral Point Zinc Company had gotten control of all mining property in the Highland region.

The Wisconsin Zinc Company was organized in mid-1908 and was an affiliate of the large American Zinc Lead and Smelting Company. The American Company had begun to look into the southwest Wisconsin field as early as 1903. Like the other large companies, and in contrast to the earlier small companies, it operated several mines at the same time during its life in southwest Wisconsin.

The Vinegar Hill Zinc Company grew from a small, independent company originating in northern Illinois in 1906, to a major force in the area's mining industry. It was eventually affiliated with the Youngstown Sheet and Tube Company and had its major holdings in the southern part of the district and its headquarters in Platteville.

<u>The corporations and the district economy</u>.--These corporations bought or leased their mining lands, built mills, roasters, separating plants to refine the ore, and shipped the concentrates to smelting, oxide, or acid plants which they or their affiliates owned. Huge sums of money, mainly non-local, were invested by them in the mining industry of southwest Wisconsin. Large purchases of equipment and supplies and utilities, by the companies, plus the expenditures made by their employees, contributed

greatly to the area's economy.

A more direct financial benefit to southwest Wisconsin from the mining industry was the tax income. In 1915 the state tax derived from the zinc mining industry was $190,578.74; the estimated amount for 1916 was $302,250.00.[26] The few large and prosperous companies contributed the major portion of these taxes. In 1916 the Mineral Point Zinc Company paid $11,278.65 to the treasurer of Mifflin Township.[27] This was just one of the townships in which the concern was operating at that time. Benton Township also greatly benefitted from the mining taxes. In 1916 three large companies alone gave over $50,000.00 in tax payment to the town treasurer (Vinegar Hill $29,044; Frontier over $15,000 and Cleveland $8,957).[28] Of these taxes 70% reverted to the local tax district, 20% went to the county and 10% to the state.[29]

Not only was the tax impact large in terms of dollars, but in relation to the taxes paid by other industries, the importance of the zinc industry can easily be seen. For 1915 the city of Platteville collected $8,553.25 in taxes. Of this sum three mining corporations and thirty-three individuals, whose principal income was derived from zinc mining and/or its royalties, paid $7,121.79 or 83% of the total. The Township of Platteville, for the same year, collected $2,994.87. Of this amount two mining companies and four individuals whose income was derived primarily from mining, paid $2,920.31 or 97%. Thus the farming industry of the entire township (a good agricultural area) paid only $74.56 in taxes

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[26] Platteville Witness and Mining Times, April 11, 1917.

[27] Platteville Journal, January 31, 1917.

[28] Ibid., February 14, 1917.

[29] Platteville Witness and Mining Times, November 29, 1916.

that year.[30]

Significance of the large companies.--Some persons considered the virtual monopoly of the district by the few big companies as a handicap to the development of the area. On the contrary, this author believes that the efficient large scale methods practiced by these firms were exactly what was needed to place the district's zinc industry on a sound and profitable basis. The success of the industry between 1905 and 1920 was dependent almost entirely upon the ability of a company to work large bodies of low grade ore at a low cost. This the big corporations were able to do. Their success was also beneficial to the local economy as indicated above.

The Mining Operation

To persons accustomed to the elaborate methods used in some other zinc mining regions of this period, the techniques applied in the Wisconsin District may have seemed crude and wasteful. Simple methods were used in both mining and milling; the mining plants, too, were not complex and small. It was thought however, by many observers after careful study of the region, that the mining system used here was generally well-adapted to existing conditions.[31]

Prospecting

Prior to the early 1900's most zinc prospecting in the region was done by shaft sinking. Zinc was usually found in or near the old lead ranges, thus prospectors would either deepen a lead shaft which

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[30] Ibid., April 11, 1917.

[31] C. A. Wright, Mining and Milling of Lead and Zinc Ores in the Wisconsin District, U. S. Bureau of Mines Technical Paper No. 95 (Washington: U. S. Government Printing Office, 1915), p. 6.

had been halted at the water table, or dig a new shaft on an old lead range. After 1900, when ore was sought well below the water table, shaft sinking was considered slow and also too expensive.

Drilling became the main prospecting method during this period. This technique was tried because in several instances well drillers of the 1800's had accidentally discovered ore while plying their trade,[32] and also by the early 1900's successful prospect drilling was occurring in the Missouri zinc fields. A variety of core drills were tried in southwest Wisconsin but did not prove successful because of the difficulty involved in recovering the cores from the area's bedrock, and also because the average cost of $3.50 per foot[33] was high.

Churn drilling, introduced to the region around 1900, became the main technique used for prospecting. It was a definite asset in the stabilization of the zinc industry in southwest Wisconsin. This drill (Figure 11), powered by gasoline or steam, churned a long steel bar with a bit screwed into the end,[34] into a hole about six inches in diameter. Through the hole cuttings or sludge would be brought up with the drill and removed in a sludge bucket. Upon reaching an ore bearing horizon, samples would be taken from the cuttings about every two feet.

In the early days churn drills were light, portable machines, not well adapted for working in very hard ground or drilling deeper than 200 feet.[35] The latter was not a handicap however, since the average drill

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[32]Even today mining companies may hire one of the local well drilling companies to do their prospect drilling.

[33]_The Miner_, 1915, _op. cit_.

[34]_Ibid_.

[35]W. F. Boericke and T. H. Garnett, "The Wisconsin Zinc District," _Transactions of the American Institute of Mining and Metallurgical Engineers_, 152 (1919), p. 1226.

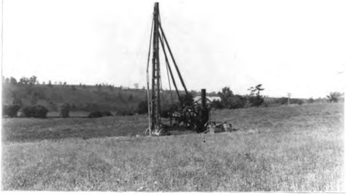

Figure 11. Churn drill. The drill rig, used for exploration purposes, was a common sight in the mining region, especially during the boom periods of the early 1900's. Its utilization helped to place prospecting on a more scientific, as well as a more practical basis. (Photo courtesy of Wisconsin State Historical Society.)

Figure 12. Miners riding in an ore tub. One leg from each of two miner's bodies can be seen protruding from the sides of the metal ore can in the shaft of the Wilkinson mine. Although a dangerous practice, inviting injury, it was commonly engaged in. Note the heavy square set timbering at the shaft base; this was necessary because of the extreme softness of the mine rock. The Wilkinson mine, located just north of Benton, was operated by the Wilkinson and later the Vinegar Hill mining companies between 1909 and 1915. (Photo courtesy of Wisconsin State Historical Society.)

hole in 1907 was less than 150 feet deep.[36] Drilling was normally done on a contract basis at a cost of $ .75 to $1.25 per foot.[37] Twenty feet in relatively hard ground was a days work.

During the early boom period demand was so great for churn drill prospect rigs that drillers from outside the district came in and found work. In fact the shortage of contract drillers became so acute that some of the companies bought their own rigs[38] and hired men to run them.[39]

The churn drilling method was relatively cheap, rapid and effective in locating zinc deposits but as practiced in the early 1900's was not without drawbacks. There was little if any supervision of the drilling by knowledgeable mining men. Few if any records were kept regarding rock types drilled through, and no surveying notes were taken. When zinc bearing sludge was obtained the usual practice was to wash the specimen thus eliminating a portion of the limestone and consequently the sample did not reveal the true percentage of zinc in the ore. Assays were rarely run; the driller would form the judgement as to whether the sample contained pay ore or not, and his report was usually taken as final on the worth of the cuttings. As a result of this general carelessness in prospecting during the early boom period, a great deal of money was spent injudiciously developing properties where the actual ore body did not warrant the expenditure.

As time passed many of the earlier deficiencies were remedied

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[36] G. E. Edwards, "The Lead and Zinc Fields of Southwestern Wisconsin," Mining World, XXVII (August 17, 1907), p. 279.

[37] H. F. Bain, op. cit., p. 144.

[38] A rig in the early 1900's cost between $400.00 and $1,000.00.

[39] The Miner, 1915, op. cit.

and additional improvements in prospect drilling were made. The rigs themselves were larger, better designed and used heavier drills than previously. More significant were the technical changes in prospecting. Practically all drilling done for the large companies operating after 1910 was under supervision of geologists or drill engineers who spotted the holes on the basis of study and knowledge of the district's structural geology. Accurate records were kept regarding strata drilled through and hole locations. Cuttings were carefully checked and if ore was found it was assayed. After an ore deposit was located it was the drill engineer's job to arrange future drill holes in a pattern so as to locate the run, length and width of the deposit.

By the end of the period under study the churn drilling technique had developed into an accurate and efficient method of prospecting. Some advantages derived from it were: (1) the ability to correctly estimate the size of a mill needed to take care of the ore body in a given period of time; and (2) the capability of placing the shaft in the best position to take advantage of the most propitious working conditions. Only a short time was required to place a property on a producing basis by being able to sink the shaft and erect the mill at the same time.[40]

Another significant prospecting change took place between the early 1900's and the post 1910 period. This concerned prospecting for future development, in an operating mine or at a new location. Before 1910 not many companies had more than a few months ore reserve blocked out in advance in an operating mine; in fact some operated simply on a day to day basis with no reserve proved up at all. No thought was given to prospecting another area which could be turned to after the current

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[40] The Miner, 1915, op. cit.

operation was finished. These companies were usually working on a small budget and had to devote most if not all of their finances to mining the ore.

The larger corporations which came to dominate the district took a different view. Before undertaking a new mining operation such a company would be sure to have a large and rich enough ore body blocked out to justify the necessary expenditures for developing the mine operation. Since the average life of a zinc mine in southwest Wisconsin was three to five years, it was also imperative for the larger companies to have new areas ready to be mined when an operating mine became exhausted. Thus prospecting by large firms was a significant and continuous process.

Opening a mine

Between 1896 and 1920 some mines were connected with the surface by side openings known as adits, inclines or tunnels, but most were opened by vertical shafts. The latter method was used almost exclusively in the latter part of the period because the deposits being worked then were too deep to be reached economically by any other method.

Although many mines had only one shaft, it was not uncommon for a mine, especially the larger ones, to have more than one. In fact it was stated that "here as in Joplin it is customary to deliver from more than one shaft to a single mill, though many of the mines are able to furnish from one, enough ore to keep the mill running."[41]

Multiple shafts were constructed for a variety of reasons, but economy was most important. It was generally cheaper to reach the ore by several shafts than by extensive tunneling underground. Other

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[41] H. F. Bain, op. cit., p. 145.

purposes for multiple shafts included pumping of water, ventilation and safety (as emergency exits).

In addition to the above listed reasons the shaft was utilized to take the men to and from the mine working level. Although nearly all shafts had ladders, the common way of transporting miners was to have them ride in an ore tub or cage. Usually four men could ride a tub, each standing with one leg inside the tub and the other leg on the outside (Figure 12). This was a dangerous way of riding, for buckets in transit would sway and bump against the shaft's side, with the possibility of injuring knee caps or legs. Still it was the principal way of raising and lowering the men.

Shaft sinking in 1915 cost from $7.00 to $20.00 per foot, depending upon its size and depth. Size, which was determined by ore tonnage to be handled, ore body depth, and water amount to be raised, ranged from five feet by seven feet to seven feet by fourteen feet, and depths were from 60 to 200 feet. It was customary to sink the shaft five to ten feet deeper than the mine's lowest working level, so as to form a sump into which mine water could drain and then be pumped out. This pit was floored over with a wooden platform used for handling ore cars or tubs. At the shaft's top and surrounding the opening was built a concrete collar. From the collar down to a depth of about thirty to seventy feet, the shaft was cribbed with timber, to prevent any loose ground from falling. In later years of the period several shafts were cribbed with concrete.

Underground development

Zinc ore deposits of this period occurred in three well-defined forms (Figure 13): (1) superficial deposits - loose chunks of galena

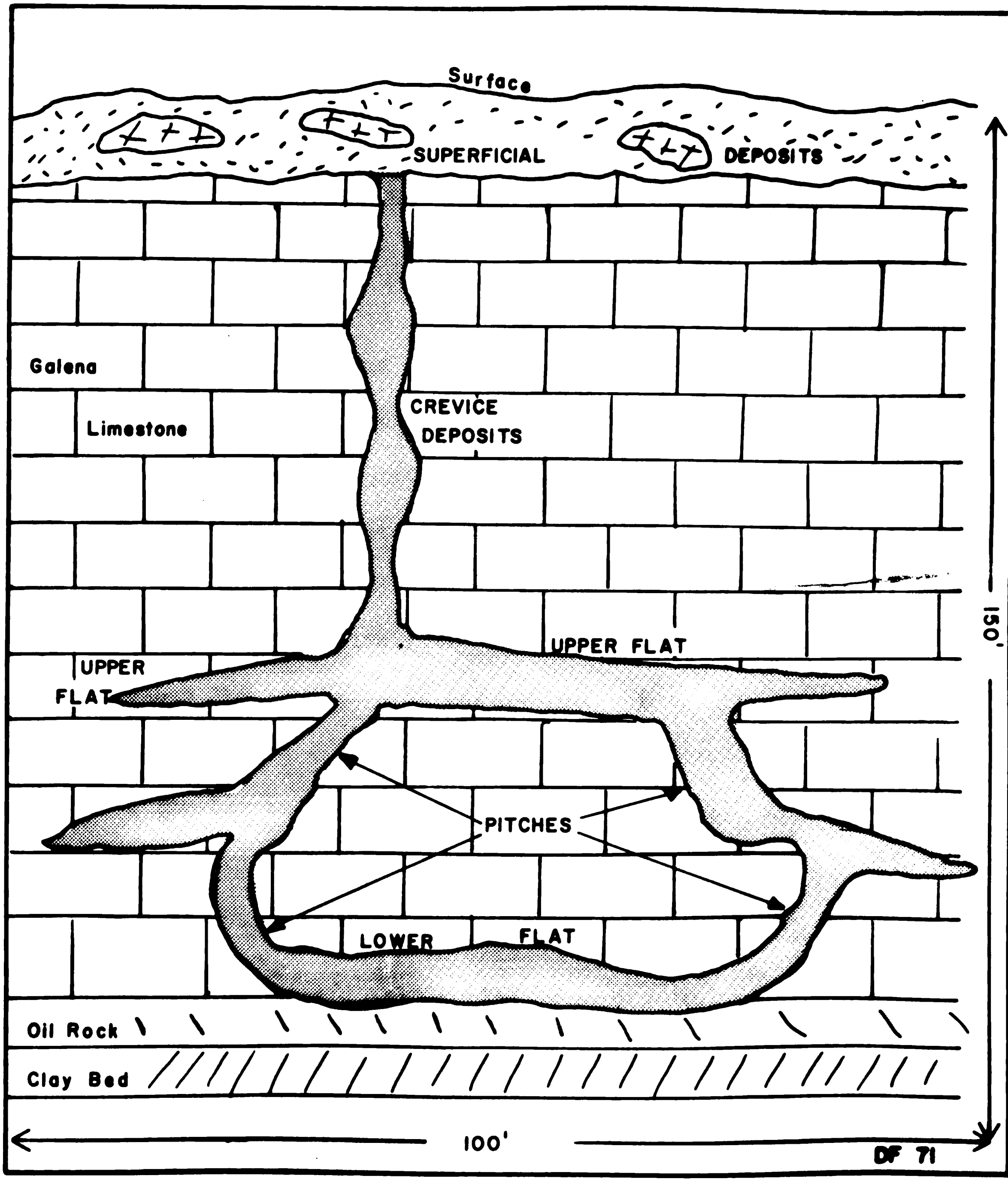

FIGURE 13. Forms of Zinc Ore Deposits

Modified from Illinois State Geological Survey Diagrams and zinc carbonate, found in the residual surface clays, (2) crevice deposits - vertical veins of lead and zinc and some marcasite, and (3) flats and pitches - zinc and marcasite fillings of horizontal cavities and inclined fissures. The latter type was peculiar to this district and the most commonly worked deposit.

Ore bodies were worked from one level. The usual system of recovery was to start at the shaft and mine away from it in all directions that showed ore. The ore was taken out (stoped) from below by a method called underhand stoping.

Underground practices of drilling, blasting, loading, transporting and hoisting were modernized during the period. As late as 1903 no drills powered by steam, compressed air or electricity were being used in southwest Wisconsin,[42] but by 1906 compressed air drills had been introduced and were being widely used then[43] and continued in use throughout the remainder of the period. These air hammer drills were improved upon so that by 1917 they were less costly and used less power than earlier models and were also lighter, requiring only one man for operation instead of two as in 1906[44] (Figure 14).

The drilling was done to provide holes to hold the explosives which would break down the ore body for loading. By the early 1900's the explosive usually used was a gelatin dynamite, which provided

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[42] Ulysses S. Grant, Preliminary Report on the Lead and Zinc District of Southwest Wisconsin ("Wisconsin Geological and Natural History Survey," Bull. No. IX; Madison, Wis.: State of Wisconsin, 1903), p. 191.

[43] H. A. Wheeler, "The Wisconsin Zinc District," Mines and Minerals, XVI (March, 1906), p. 370.

[44] H. K. Sherry, "Some Improvements and General Notes on Wisconsin Zinc Mining Practice," The Miner, Yearbook of the Wisconsin State Mining School, III (Platteville, Wisconsin, 1917).

Figure 14. Underground drilling. The common drill used was a compressed air type mounted on a tripod. The limestone rock of southwest Wisconsin did not wear down the bits as fast as the flint in the Joplin district. Still drilling was relatively slow, for the rock is compact and breaks down into a fine powder which is apt to accumulate in the holes when drilling. That difficulty was overcome in part by using water-type hammers which kept the holes washed out as drilling continued.

Figure 15. Shoveling from steel plates. The steel plate in the foreground is the type that was usually placed flat on the ground at the end of the haulage track and in front of the working face, to permit easier shoveling. In this picture the worker is about to reduce the size of several large boulders with a sledge hammer before shoveling the ore into cans. The broken material will fall on to the plate on which he is standing.

distinct improvements in safety and efficiency over the formerly used black powder. The explosives were kept in a surface magazine placed at a considerable distance from other structures.

After the blasting occurred, which usually was at the end of a shift, the broken ore fell onto sheet iron plates, ready for mucking (loading) at the beginning of the next shift. The shoveling, done entirely by hand until the last few years of the period, was made easier by the steel plates since they provided a smooth, flat working surface on the floor of the drift (Figure 15). The muckers using large scoop shovels would load the dirt into tubs or cars having capacities of about 1,000 pounds (Figure 16).

The broken dirt contained many large boulders which would be "drilled and shot" over again or smashed by the muckers with sledge hammers. Selective mining was still carried on since the loaders would place barren boulders into special cars the content of which was then taken directly to the mine dump. About fifty tons of waste rock would be culled from the average 150 tons of rock broken in a day.[45]

Mechanical loading, by electric shovel, was first attempted in this district in June, 1916 by the Vinegar Hill Company. Later other mines installed such loaders. Although there were drawbacks to mechanical loading it was used successfully and eventually replaced hand mucking entirely.[46]

Loading of the dirt was followed by haulage or "tramming" to

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[45]"The Enterprise Mine," Engineering and Mining Journal, LXXXII (September 8, 1906), p. 445.

[46]It was said as late as 1917 that "the #2 scoop in the hands of a good man is still the cheapest way to get dirt into the small cars or cans used in the district" (Sherry, *op. cit.*).

Figure 16. Shovelers at an ore tub. The shovelers or "muckers" were responsible for filling the tubs or cans nearly to the top - they were not filled completely in order to prevent spillage during hoisting and injuring persons below in the shaft. Displayed in the photo are the D handle scoop, pick, and sledge hammer, common tools of the shovelers. Loading was followed by pushing or hauling the cans on low, flat cars to the base of the shaft where hoisting would take place. The job of mucking and tramming was usually paid for on a contract basis - 6 to 10 cents per can loaded and hoisted, enabling good workers to earn $3 to 3.50 per day.

Figure 17. Underground locomotive haulage. Mechanical power replaced man or animal power in the hauling operation in several mines of the period, such as here in the Lawrence mine. This mine, located in the Hazel Green subdistrict, was operated by the Cleveland Mining Company between 1913 and 1917. (Photo courtesy of Wisconsin State Historical Society.)

the shaft. In the early boom period trammers, who in some mines were also the muckers, would push ground cars carrying the ore-filled tubs along rails to the shaft base. In some mines mules were used to haul the ore cars to the shaft. The mules were kept underground, being maintained in a barn at one end of the drift. By the end of the period gasoline locomotives were being utilized for haulage (Figure 17), but haulage by a rope system, electric or compressed air locomotives, which were used in other American mining districts were never attempted in southwest Wisconsin.[47]

Once at the shaft base the ore was raised to the surface by using a simple hoist in a derrick or headframe placed above the shaft. Although horse-operated hoists were still being used in the early 1900's it was more common for the bucket (ore tub) to be lifted by electric, gasoline or steam power. In 1905 the first hoisting cage was introduced to the district at the Trego mine near Platteville.[48] The cage, which was commonly used after 1910 was utilized for hoisting underground ore cars. The hoists in larger mines were from thirty-five to seventy-five horsepower and made a roundtrip with a hoisting load in twenty-five to forty-five seconds. Two hundred to five hundred tons of dirt could be handled in a typical nine hour shift. After arriving at the surface the ore would be dumped into storage bins or onto a chute leading to the processing mill.

During the early 1900's ore was hauled from mine to mill by wagon. By 1915 however most shafts had storage bins and were connected directly

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[47] H. C. George, "The Wisconsin Zinc District," Engineering and Mining Journal, C (1915), p. 344.

[48] Platteville Witness, June 17, 1905.

with the mill hopper. If hoisting was done from more than one shaft the ore was trammed to the mill hopper by inclined or horizontal tramways, or in a few instances by aerial tramway (Figure 18). The surface tram cars were self-dumping, with capacities of one or two tons. The mill hoppers to which the ore was taken were built of timber and had capacities of 100-300 tons.[49]

Power

One of the most backward aspects of southwest Wisconsin's zinc mining industry was the type of power used. A mining industry publication as late as 1901 stated, "Nine-tenths of the mines are worked by horse and manpower . . . drills are largely operated by hand, and hoisting is frequently done by hand windlass. . . ."[50]

Until 1910 most mechanically-powered mining operations were conducted with the use of steam power, generated by burning coal or by using gasoline or oil engines. Small gasoline engines (20 hp) were increasing in use during the early 1900's[51] and with such, water pumps and the hoist could be operated. Coal was however, the main source of power in the mining operation.

Coal had been used in large quantities before 1910 for furnishing heat as well as power, and it was a significant item in a company's operation. It was not completely satisfactory for many reasons. Coal was expensive[52] and often unavailable due to blocked rail lines in

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[49] C. A. Wright, op. cit., p. 19.

[50] R. P. Rothwell (ed.), The Mineral Industry (New York: Scientific Publishing Company, 1901), IX, p. 663.

[51] Platteville Witness and Mining Times, September 26, 1906.

[52] Low grade Illinois coal in 1906 cost from $3.25 to $4.00 per ton.

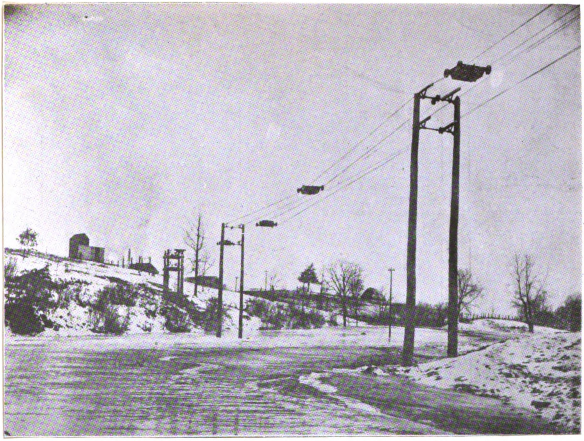

Figure 18. Aerial tramway haulage. Some of the more successful mines utilized this type of surface transportation to transfer ore from mine to mill. This aerial system was located at the Klar-Piquette mine about four miles southwest of Platteville. The mine was operated by the company of the same name between 1907 and 1915. It was one of the most prosperous mines of the period.

winter and muddy wagon roads in spring. Then too, the steam boiler water of the district was bad, since its corrosive action and sediments deposited in the boiler shells caused many shutdowns of power plants.[53]

Thus mine owners began turning to electricity as a source of power. Special notice was taken in 1903 of the Hazel Green Mining Company installing four electric engines to supply power for hoisting, drilling, lighting, surface transportation or ore and running the mill.[54] Still, the use of electricity was not yet widespread throughout the district.

It was not until the Interstate Light and Power Company, with main headquarters at Galena, Illinois, began to bring electricity into the district that much progress was made toward electrification. After its large central power station was completed in 1910, by 1913 power transmission was extended to Platteville, Rewey, Livingston, Mifflin and nearby areas.[55] Many operators quickly began to contract for electric power.

In 1912 the Mineral Point Public Service Company was organized for the purpose of supplying electricity to its surrounding area in the northeast part of the district. During that year its main transmission line was completed to Livingston, Mifflin, and Linden, and soon thereafter was extended to Montfort and Highland.

By 1914 power lines from one or the other of these two companies ran to all of the important mining centers in Wisconsin, making electricity

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[53]F. H. Rickeman, "Test for Power Input for Operating the Equipment of the Lead and Zinc Mines in Southwest Wisconsin" (unpublished M.S. Thesis, University of Wisconsin, 1909), p. 63.

[54]<u>Grant County Witness</u>, September 16, 1903.

[55]<u>Platteville Witness and Mining Times</u>, February 17, 1912.

available to most mines.[56] The switch to electric power was almost a total one. Of sixty-six operating mines in 1916, four used steam, six used gasoline, and fifty-six used electricity for power.[57] Still not all power problems were solved for the power companies could not keep up with the demands, and interruptions in service were frequent. The situation was remedied by extensive additions to the generating plants.

Water

Mining below the water table resulted in the serious problem of mine drainage. As one Wisconsin writer said, "There is no other machine about a mine upon which the future of the mine so much depends as upon the pumps for keeping the underground workings drained. . . ."[58] The problem was especially serious in the southern part of the district where mines were deeper.

The type of pump used changed during the period under study. The old style, horse-drawn, walking beam pump was still being operated in a few mines as late as 1915, but by then it had practically disappeared.[59] The Cornish lift pump, a simple but effective machine, was widely used. More economical and efficient pumps were designed however, and by the late teens motor driven triplex and centrifugal pumps were the most widely used.

Inadequate pumps and high cost of pumping were sometimes causes

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[56] G. H. Cox, Lead and Zinc Deposits of Northwest Illinois (Illinois State Geological Survey Bulletin No. 21; Springfield, Illinois: Illinois State Journal Co., 1914), p. 105.

[57] The Miner, 1917, op. cit.

[58] Rickeman, op. cit., p. 51.

[59] Wright, op. cit., p. 18.

of a mine shutting down. If a pump broke down the mine would flood in a short time. It was reported in 1917 that the Vinegar Hill Company was using a boat to repair a broken pump in one of its mines.[60] Thus, miners sometimes became sailors.

Although water drainage had to be accomplished, it proved to be a more serious problem than at first anticipated. With adequate pumps, however, the mines were drained efficiently. In fact the water pumped out of the mine was often useful in the milling process. Some mines had so much water they ran it directly to the concentrating plant and needed no pond for recycling water for further use. Others had so little that it was necessary to bring water from nearby streams for ore processing.

The pumping of water had several noticeable effects on the region. When the water was finally turned away from the mine it would take its natural course to the nearest stream. Large areas were covered with sediments laid down by the water when it ran off in sheets, while other areas were cut up by erosional gullies where the runoff was channeled into ditches. Another effect was that because so much water was being taken from the ground water supply to keep the mines dry, the water table was lowered and domestic wells next to mines had to be sunk deeper. Not uncommonly springs and wells dried up while a nearby mine was in operation, but resumed flow when it was abandoned.[61]

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[60] Platteville Journal, op. cit., February 28, 1917.

[61] George Heitkamp, "Grant County, Wisconsin; Relation of the Life and Industries of the People to Its Geology and Physiography" (unpublished B. A. Thesis, University of Wisconsin, 1912), p. 20.

Ore Processing

A major factor in the great upward surge of zinc mining in southwest Wisconsin during the 1896-1920 period was the innovation that took place in the concentration of the local ores. The principal advance was the roasting-magnetic separation process which took previously low value ores and made them very valuable. Wisconsin ores were sold to smelters in many parts of the nation travelling over the well developed rail net which served most mines of the district.

Early processing

Before 1900 there was little change in mineral processing methods from the previous periods. Although in a few instances new processes and machines were being tried, the majority of mining companies were still preparing ore for market by the old time-tested methods of hand separation and jigging.

Smithsonite.--After coming from the mine the drybone would be cleaned and sorted into three categories for market: (1) large, coarse, hand picked pieces, (2) the washed or jigged pieces, and (3) the finer portions called "smittems." The first grade commanded the highest price and was the primary objective of the selective mining operation. It was the cleanest and had the highest percentage of oxide. Several mines continued to produce large quantities of this grade of ore for many years.

The washed drybone was in smaller fragments and had been separated as much as possible from iron oxide, blende, and rock by the jigging process. The impurity limonite was not easily separated from the drybone, and the amount present in the final product determined the value of this class of ore. The fine smittems, contaminated with non-removable heavy ocherous clay, limonite, and ferruginous rock, were the least valuable grade.

Most of the region's drybone went to the Mineral Point zinc works where it was manufactured into zinc white by a relatively simple process. At the plant the ore was ground fine, mixed with crushed coal and put into a forced air blast furnace on top of a burning mass of coals. Oxide in the form of a greenish smoke, escaped from the furnace through a series of pipes which led to a bag room. In this room the oxide smoke would be collected in large unbleached bags, transported to the packing room and stored in 200 pound barrels.[62]

Sphalerite.--The blackjack ore was also being prepared for market in three grades: (1) the massive hand culled jack, cleaned as much as possible of all rock, pyrite, bone and lead; (2) medium sized fragments, picked out from mixed or broken ores and washed clean at the mines; and (3) jigged ore or smittems.

The first grade commanded the best price because it was in greatest demand by the smelters, even though it did sometimes carry considerable amounts of non-removable pyrite scales. The second grade contained still more pyrite and brought a lower price. These two grades of jack were separated from the freshly mined dirt on sorting tables by men or boys using a short curved hook. The jigged ore was least valuable because it was usually impossible to obtain any large quantity of ore by this process that was not heavily contaminated with pyrite.

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[62] Grant County Witness, July 14, 1897.

Introduction of new processing techniques

The peculiar character of the local sphalerite ore was a major reason for the slow development of the Upper Mississippi Valley's zinc industry. The ore was an intimate mixture of the iron sulphide[63] (pyrite-marcasite) with the blende, and smaller amounts of galena, in a gangue of calcite and dolomite.

The prevailing separation method of the time, jigging, could not sufficiently overcome the close association of zinc and iron in much of the ore to secure a commercially acceptable product. This was because the hydraulic method, relied upon in jigging, was based upon the difference in minerals specific gravity; the specific gravities of blende and iron however are nearly identical. The best product of the jigging process would contain about 35% zinc, 18% iron and less than 1% lead. This concentrate was not acceptable to most smelters, since they could not utilize ore carrying more than 7% iron.[64] Thus, this resulted in a distinct handicap to the district.

Some attempts were made before 1890 to separate the zinc and iron by burning. These were however ineffective and soon were abandoned. The result was that by the early 1890's many zinc mines had closed or were being worked only part-time, because of the inability to adequately separate the ore. Thus as the demand and price of zinc rose in the 1890's it was deemed necessary by the area's mining men to develop a process whereby the large deposits of zinc blende-iron sulphide ores of the district could be made merchantable.

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[63]Known to the miners as sulphur or mundic.

[64]U. S. Geological Survey, Mineral Resources, op. cit., 1905, p. 382, and Blake, op. cit., p. 569.

The Wisconsin Lead and Zinc Company hired a professional engineer, William P. Blake of New Haven, Connecticut and Shullsburg, Wisconsin, to develop a process to successfully separate zinc and iron.[65] Blake perfected a furnace and roasting technique that desulphurized the FeS_2 and changed the physical properties of the marcasite so that its subsequent separation by gravity became possible. This method was first used successfully at the Helena mine, three miles west of Shullsburg, in 1892. Following Blake's success several other new methods and machines were introduced for the separation of the zinc and iron. The most important of these was the development of a process for magnetic separation of the iron from the blende after the ore had been roasted.

One deleterious effect resulted from the new roasting process, however. Roasting produced a large amount of sulphurous acid, which at first was allowed to escape as a gas into the atmosphere. Eventually several plants utilized the gas in the manufacture of sulphuric acid, but the escaping gas at other places in the region caused problems for many years. The gas withered vegetation near the roasters and thus affected the extent of cultivated land. It was also recorded in 1916 that fumes from a roaster west of New Diggings "poisoned the cattle, killed vegetation, rotted wire fences and screen doors, and poisoned water in the creek."[66]

Still, in spite of some harmful effects, the development of the roasting (and later the magnetic separation) process was a great boon to the area's mining industry, and its importance can not be overemphasized.

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[65] The process is described in detail in W. P. Blake, "The Separation of Blende from Pyrites, A New Metallurgical Industry," Transactions of the American Institute of Mining Engineers, XXII (1894), p. 569-574.

[66] Mrs. Margaret S. Carter, New Diggings is an Old Diggings (New Diggings, Wisconsin: privately printed, 1948), p. 79.

As an example, one mine received $10 per ton for its zinc product before using the roasting-magnetic separation process. In 1903, after installing a roaster and magnetic separator for processing its zinc product sold for over $30 per ton. Even after the substantially increased costs of using the new technique were subtracted, the mine's profit was still twice as much as formerly.[67] The Grant County Witness was correct in 1902 when it foresaw the opening "of a new era in mining in this district,"[68] based on the new methods of separation.

Prevailing methods of ore processing

Mine dirt hoisted from underground assayed up to 15% metallic zinc, with an average of around 5%. Treatment of the ore was necessary to bring it up to a quality acceptable by the smelters. Most ore of the district was processed locally by the techniques of milling and concentration. The assay value of concentrate upon leaving the region ranged from 15% to 60% zinc.[69]

Milling.--Milling was a simple operation, consisting basically of crushing and jigging the ore. The typical mill contained crushers, rolls, jigs, trommels (for sizing), and elevators. The mine dirt was first dumped on a series of bars, called the grizzly, horizontally placed over a large hopper. The grizzly provided the first opportunity on the surface for culling out waste rock, by hand, and also acted as a sizing device. After being put through the grizzly, the ore would pass through

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[67] Grant County Witness, May 20, 1903.

[68] Ibid., January 15, 1902.

[69] Walter Schultz, "The Milling of Lead and Zinc Ores in the Southwest Wisconsin District," The Miner, Yearbook of the Wisconsin State Mining School, III (Platteville, Wisconsin, 1917).

crushers and screens on its way to the jigs.

Jigging between 1900 and 1920 used more sophisticated machinery than had been used before the turn of the century, but the process was basically the same. This type of separation was based upon the relative specific gravities of the minerals involved, and machines utilizing the principle of hindered settling were used almost exclusively.

The primary function of the jigging process was to separate the three basic products of the jig mill from each other, i.e., galena, blende, and waste material (tailings). Galena was often entirely absent from the ore, but when present and processed, it was ready for market as lead concentrate. The blende usually included the hard to remove marcasite. Thus the Wisconsin zinc ore concentrate had an average grade of only 20-35% after milling.[70]

Tremendous quantities of water, a minimum of 700 to 1200 gallons per minute, were used in the jig milling process. Usually, water pumped from the mine was sufficient to supply required amounts. Mine water was first pumped into a mill pond (Figure 19) and from there into the mill. Often it would be used over and over again. After passing through the jigs it would go to a settling tank or pond and then back to the mill pond again. If water coming from the mine was inadequate to operate the mill, additional amounts would have to be pumped from the nearest creek, sometimes hundreds or a thousand feet away.

After milling the lead and zinc concentrates were moved to storage bins, and the waste to the tailing piles. In 100 tons of mine dirt there were commonly about eight tons of marketable zinc, and one-sixth of a ton

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[70]Boericke, op. cit., p. 1223.

Figure 19. Sunrise mine mill. A typical wooden, level site type of mill structure in the early 1900's. Coarse tailings are at the left, the fine tailings pile is at the right and the mill pond is in the foreground. The Sunrise mine was on a part of the famous Coker ore body, located just north of the village of Rewey. It was opened in 1899 by the Sunrise Mining Company and operated until 1911, after which the property was purchased by the New Jersey Zinc Company, along with several others in the vicinity. (Photo courtesy of Wisconsin State Historical Society.)

of lead.[71] The tailings were, at times, also merchantable. There was a cement brick and block industry in the district that used mine tailings as a raw material. Platteville had three such plants in 1906 and several were present at other locations.[72] The tailings were sometimes sold for street paving and railroad ballast.

The mills.--Mills were numerous in the district. In 1906 Bain found that of seventy-three mines, thirty-nine had mills. As time passed and mining became almost entirely non-selective, nearly every mine had its own mill. In 1908 fifteen new mills were constructed, in 1909 twenty, and in 1910 eight more. Also some mills were moved from abandoned mines and rebuilt at newly opened ones.

Practically all mills were built by local companies, especially the Galena Iron Works, and thus were of the same general type (Figure 19). Constructed of wood with concrete foundations, the buildings were of the "level site" type and used elevators and conveyors to take rock and ore from one treatment to the next.

The usual practice was to build a mill immediately adjacent to the mine's shaft, so the ore could be hoisted directly from mine to mill hopper. Such a mill location simplified ore handling and reduced costs. Frequently, however, the ore was conveyed as much as one half mile on the surface, from shaft to mill. In such cases a hopper at the shaft head fed a conveyor belt or aerial tram car with ore and it in turn carried ore to the processing plant.

The mills usually had a small capacity at first, 35 to 50 tons

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[71] W. R. McConnell, Mineral Resources of Southwest Wisconsin, Quarterly Report of the Wisconsin State Normal School at Platteville, XIV (Platteville, Wisconsin: State Normal School, n.d. ca 1915).

[72] Platteville Witness and Mining Times, June 6, 1906.

per ten hour shift. By the middle of the period however, mills with over 100 tons capacity were common. In addition to building most of the mills, the Galena Iron Works also supplied most of their equipment. The company produced a type of machinery that was well suited to the soft rock ores of the Wisconsin district. The cost of building and equipping a typical mill ranged between $10,000 and $30,000.

The mills generally ran only a day shift of ten hours. When a mill was operating in conjunction with a roaster however, it usually ran two shifts to keep the roaster supplied with ore. Commonly there were three men on a shift: the crusher-feeder, earning about $1.76 per day in 1906; the jig man or millman who was in charge of the jig operation and earned about $2.50 to $3.50 per day; and the backer or wheeler who transported the concentrate to the bin and sometimes aided the millman, earning $1.75 to $2.20 per day.[73]

Concentration of the milled ores.--The zinc, coming from the jig mill was intimately mixed with a considerable quantity of iron sulphide which had to be removed before the ore could be marketed. By 1905 the separation of zinc and iron was being accomplished in several ways.

At the Mineral Point zinc works fumes from roasted ore were converted by a contact process into high grade sulphuric acid, and the iron-zinc oxides were left on the furnace hearth. The oxides were then burned in the oxide furnaces, the zinc being caught in bags and the iron remaining on the grates.

Electrostatic concentration, a second method, had been tried early in the period at the Empress mine near Benton. Although used for

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[73]"Ore Milling in Wisconsin," Engineering and Mining Journal, LXXXII (July 28, 1906), p. 152.

several years particularly at a large plant in Platteville, it never became widespread in the region.

A third method, roasting and magnetic-separation was widely adopted, and long used in the district, and deserves additional attention.

Roasting and magnetic separation.--This technique was developed just before and utilized throughout the entire part of the time period studied in this chapter. It consisted of two parts: (1) roasting (or calcining) of the ore, and (2) treatment of the calcined ore upon magnetic separators.

In the first stage the milled ore was given a light roast in a long, steel rotating cylindrical furnace lined with fire brick. About one-third of the sulphur was driven off and the iron particles were rendered magnetic. After being roasted the ore was delivered to the magnetic separator, where the magnetic oxide was picked out by electromagnets. From there the incompletely roasted and magnetic sulphide particles went to the tailings pile and the zinc product to ore bins from which it was loaded on railroad cars for shipment to smelters.[74] The zinc product assayed from 57% to 61% metallic zinc and less than 3% iron.

There were several limitations to the roasting-magnetic separation process, including cost and mechanical details. The chief disadvantages however, were the loss of sulphur in the marcasite and the loss of zinc.

Much of the sulphur was burned off in the roasting process, and

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[74] Frank H. Trego, "Roasting for Magnetic Concentration of Zinc Ores," The Engineering and Mining Journal, March 30, 1907, p. 613.

this was considered wasteful, as there was a market for sulphur at $3-6 per ton. Also, as mentioned earlier, the sulphur fumes escaping through the stack had a very destructive effect on the surrounding landscape. The sulphur loss problem was, for the most part, solved by the period's end; dust bags were placed in the roaster stacks to catch the escaping fumes. Then too, it was found that by only lightly roasting the ore, the separator's iron sulphide product would contain enough sulphur to sell to acid manufacturers. In fact many roasters eventually had equipment to manufacture sulphuric acid.[75]

The loss of zinc was more difficult to overcome. In the roasting process there was a loss estimated at 3½% of zinc in the form of fine particles which were blown through the stacks. In 1920 the zinc industry was still searching for a solution to this problem, but it was not solved until almost a decade later.

Although most mines had mills, only a few had roasters-separators. Bain, in 1906 indicated that of seventy-three mines, thirty-nine had mills, but only sixteen had roasters.[76] The primary reason for the small number of roaster-separators was the mine owners believed it to be more economical to sell the green (non-roasted) concentrate, rather than invest in a costly roasting plant. In addition to the costly machinery, other factors pushed up the cost. Because of the fire danger the plant's elevators

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[75]During World War I the federal government began to build two sulphuric acid plants in the area; one was located near New Diggings, the other just southeast of Cuba City. Sulphuric acid was then in great demand for war purposes, especially in the manufacture of explosives. The two plants, to cost $1,500,000 each, were only about 70% completed when the Armistice was signed in 1918 and the government ordered their construction halted. A short time later the plant at New Diggings was purchased as junk for $40,000.00 by a Chicago firm. The National Zinc Ore Separating Company, then operating a plant at Cuba City, purchased the nearby unfinished acid plant and spent over $100,000 in addition to make it operative.

[76]Bain, op. cit., pp. 9-10.

and bins were usually made of iron. Also to provide greater safety and reduce fire insurance premiums, the plant would have had to be located in a separate building. Then, too, although usually only two men were needed on a shift, because the roaster-separator had to operate continuously (stopping only on Sundays) extra shifts of men would have had to be hired.[77]

Few additional roaster-separator plants were built after 1906 - until 1915. In that year the operating roasters were unable to handle the district's output of green concentrate and they began to accumulate at the jig mills. This helped to spur expansion of the processing industry, for later in that year and continuing for a few years thereafter, new roaster-separator plants were constructed. Still these plants were few in relation to mills and mines. Statistics indicated however, that nearly all ore that left the Wisconsin district was processed in roasters and separators.[78] This meant that several of the plants were "custom" operations, i.e., plants owned by one company, which would purchase green concentrates from numerous other companies for further processing. Here, too, the big companies dominated the industry. In 1918 and 1919, 80% of all raw concentrates treated in Wisconsin were handled at the roaster plants of the Vinegar Hill, Mineral Point, and Wisconsin zinc companies.

Major concentrating plants

The number and type of concentration plants changed during the period. Some were large custom plants handling ore of many companies; others were small, one company plants. All were very important to the continued development of the district, because they provided a market

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[77] U. S. Geological Survey, Mineral Resources, op. cit., 1914, I, p. 117.

[78] Ibid., 1915, p. 879.

for low grade ores, which previously had little or no value. Some of the more important concentrating plants of the district before 1920 were the Platteville Separator, Campbell Magnetic Ore Separator, National Separator, Skinner Roaster, the Mineral Point Zinc Works, all of Wisconsin, and two Galena, Illinois plants.

Platteville Separator.--In late 1907 construction on a separation plant was begun in Platteville by the American Zinc, Lead and Smelting Company. The facility, completed in early 1908, utilized an electrostatic separating process thereby saving the cost of roasting and the accompanying loss of zinc and sulphur. Ores of 30% zinc and 20% iron could be utilized, turning out a zinc product assaying 56% zinc and 4% iron, and an iron product of 39% iron and 5% zinc.[79] The marcasite, separated from the zinc product and lost in the roasting process, became a merchantable material as a result of use of the electrostatic process. It sold for $4 per ton in 1910.[80] The plant appears to have been highly successful; it was handling 100 tons of raw dirt every twenty-four hours in 1910.[81]

Unfortunately for the local zinc industry, and for Platteville in particular, a serious fire destroyed the separating plant in October, 1911. Its workers became unemployed and numerous mines producing low grade ore had to shut down. Only two other plants of this type were in operation in the world at that time; one in Utah, the other in Mexico. It was expected that the plant would be rebuilt, but it never was. Several theories were given as to why not. One was that the climatic conditions

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[79] Ibid., 1907, p. 257.

[80] Ibid., 1910, I, p. 670.

[81] Platteville Witness and Mining Times, September 14, 1910.

in southwest Wisconsin were not the best for the electrostatic process. The process was found to be much better adapted to use in a drier climate. Perhaps the most plausible theory, however, was that the roaster-magnetic separation process was cheaper and produced a more satisfactory product.

Campbell and National Separators.--Both plants were located in Cuba City. The Campbell Magnetic Ore Separator was completed in 1910, and became the property of Wisconsin Zinc Company in 1913. It had a capacity of about 300 tons of milled ore per week. The National Separating Company, affiliated with Vinegar Hill Zinc Company, completed a plant in Cuba City in 1916. Its capacity was about 1,000 tons of green concentrate per week.[82]

Skinner Roaster.--The Skinner Roaster, owned and operated by the Wisconsin Zinc Company, was built in 1915 by L. B. Skinner. Located one half mile west of New Diggings, the four-story concrete and steel building housed a roasting furnace, eight magnetic separators, and a modern assay lab.[83] Because of its capacity of 150 tons of green ore in twenty-four hours, the plant was a great boon to miners in the southern fields and soon had a large output. As a result, the Chicago and Northwestern Railroad put a branch line in to it from its main track. This roaster was similar to the one at Mineral Point, except the fumes produced in calcination were not used for the manufacture of sulphuric acid.

Galena roasters.--Two roasters in Galena, Illinois, also attracted considerable amounts of Wisconsin ore during the period, especially from the southern part of the Wisconsin district. These were the Joplin Roaster

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[82]H. C. George, "The Wisconsin Zinc District," Transactions of the American Institute of Mining and Metallurgical Engineers, 59 (1918), p. 144.

[83]H. D. Weidman, "The Skinner Roaster," The Miner, Yearbook of the Wisconsin State Mining School, 2 (Platteville, Wisconsin, 1916).

and the Field Mining Company Roaster. The Joplin Roaster was a custom plant built before 1910. Although destroyed by fire a few days after the Platteville separator burned, it was rebuilt with a larger capacity and continued to be a leading producer of zinc for many years.

The Mineral Point zinc works

(Figures 20 and 21). The Mineral Point Zinc Company which had provided an incentive for continued zinc mining in southwest Wisconsin during the 1880's began to have financial problems in the early 1890's. Profits became slimmer, due mainly to low prices for zinc oxide on the national market. A major factor in the low pricing was the competition between two eastern companies, the New Jersey Zinc Company and the Lehigh Zinc and Iron Company. Aided by the Jones Brothers, however, the former soon took over the holdings of the latter.[84] This was followed in 1897 by the Mineral Point Zinc Company becoming an affiliate of the New Jersey Zinc Company. This merger enabled the Mineral Point Zinc Company to have standing behind it the nation's largest producer of zinc oxide and one of the largest producers of spelter. The price of zinc oxide improved, production at the Mineral Point zinc works boomed, and expansion was again in order.

In 1897 the zinc works consisted of a large stone building covering more than two acres.[85] Within the plant were four main departments: (1) the furnace or smelter proper, (2) the bag room, (3) cooperage, and (4) the storage area. Three shifts of eight hours per day, seven days a week were used, employing 100-200 men. Seventy-five to one hundred tons

[84] McConnell, op. cit., p. 29.

[85] Iowa County Democrat (Mineral Point, Wisconsin), September, 1891.

Figure 20. Mineral Point Zinc Company plant. View to the southeast during the early 1920's. The large building in the right-center background with the six steep ridged roof projections held the bag rooms. The roof tops contained side openings to ventilate the building. To the right was the roaster and its stacks. The three small buildings in the center were from left to right: the general warehouse (flat roof), carpenter shop, blacksmith shop. (Photo courtesy of Wisconsin State Historical Society. Identification supplied by Mr. Jack Adams, Mineral Point.)

Figure 21. Mineral Point Zinc Company plant. Early 1920's view to the southeast but from a point farther northwest than where Figure 20 was taken. The building in the left foreground with the large stack is the power house. To the left is a part of the plant office. The structure with the partly dismantled stack had been a machine kiln where the jack was calcined. To its left, along the railroad, is the ore receiving and unloading building. (Photo courtesy of Wisconsin State Historical Society. Identification supplied by Mr. Jack Adams, Mineral Point.)

of ore were processed each day, yielding approximately twenty tons of oxide. The entire plant was lighted by electricity.[86]

The year 1899 was the beginning of an expansion and diversification program that continued for many years. Between the spring and fall of 1899 ten new furnaces were added. Area towns were visited by company officials in October, 1899 for the purchase of 400,000 building bricks for additional improvements. One new structure was to be a chimney tower 150 feet high.

A very important addition to the company's products was sulphuric acid. In late 1899 the Mineral Point Zinc Company purchased everything of the Mineral Point Pulp and Paper Mill, except its machinery, for the purpose of providing space to manufacture sulphuric acid. This plant, located adjacent to the oxide plant, but west of the railroad tracks, was to employ an additional work force of fifty to sixty men.

Another significant diversification in production was launched in 1903 when it was announced that a kiln for the calcining of blende was to be built. This gave the Wisconsin firm three major products of the zinc industry - oxide, sulphuric acid, and zinc metal.[87]

Expansion continued with numerous additions or improvements being made at the plant between 1903 and 1910. It was reported in 1907 that the zinc works covering fifty-two acres, was employing 300 men, and was annually shipping 18,000,000 pounds of oxide and 11,000,000 pounds of acid.[88] About 1910 a new steel and concrete oxide plant was built next to the old

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[86] Grant County Witness, July 14, 1897.

[87] Data regarding expansion was obtained from the Grant County Witness, 1899-1903.

[88] Tri-State Yearbook, op. cit., p. 91.

one which was then dismantled, and a new power plant was built shortly thereafter.

The success of the zinc works was accomplished in spite of several problems. In early 1900 a serious fire, one of several the company experienced, shut the plant down temporarily with an estimated $8,000 damage.[89] There were times when the plant was closed because of a lack of ore. It was not that local ore was not available, but apparently the Mineral Point Zinc Company was offering less for it than were out-of-state buyers. Another problem was the recurrent rumor that the zinc works was going to go out of business. This did not foster customer confidence. Labor shortages also necessitated shutdowns at certain times. During the critical period of the war years, the labor problem was partially solved by having high school boys work nights, holidays and weekends to keep the plant in full operation.

In spite of these and other handicaps the Mineral Point Zinc Company did a flourishing business during the second decade of the Twentieth Century. The war demands for zinc and sulphuric acid created favorable market conditions. The oxide works during the war years operated at full capacity and at its peak produced 350 barrels (100 tons) of oxide per day.[90] The production of acid which had been temporarily discontinued just prior to 1910 was revived after a new plant was built. This was prompted by the rise in the price of sulphuric acid from a prewar price of $8 to one of $80 to $100 per ton.[91] Six to seven cars of acid were being

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[89]"History and Guide to Mineral Point," op. cit.

[90]George Fiedler, Mineral Point, A History (Mineral Point, Wisconsin: The Mineral Point Historical Society, 1962), p. 183.

[91]"History and Guide to Mineral Point," op. cit., p. 262.

produced per week in 1916.[92] The skinner type roaster used in the production of zinc treated about 1500 tons of green zinc concentrate per week, yielding a richer concentrate assaying 57% to 59% zinc metal.[93]

In 1920 the zinc works of the Mineral Point Zinc Company represented a $6,000,000 investment,[94] as compared to an investment of $2,000,000 in 1900.[95] It was the leading industry of Mineral Point and of southwest Wisconsin. In 1918 alone it paid to its community more than $40,000 in taxes.[96] It furnished most of the traffic for the Chicago, Milwaukee and St. Paul Railroad in the region. One month's business included 147 cars of ore brought in to the zinc works and shipments out of 58 cars of oxide and 20 cars of sulphuric acid. The regional product next in importance in outgoing traffic was cheese which accounted for only 19 cars.[97]

Very important was that the Mineral Point plant, and others like it in the district, gave mining a greater degree of stability. For without these plants much of the ore mined in southwest Wisconsin would have had no value. This type of plant was the scavenger of the zinc industry. The Mineral Point plant utilized low grade zinc ores not only from Wisconsin but also from Colorado, New Mexico, Tennessee and Canada. About thirty carloads per week were received from Wisconsin mines, which

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[92] McConnell, op. cit., p. 30.

[93] George, op. cit., 1918, p. 143.

[94] Wisconsin State Journal, (Madison, Wisconsin), December 29, 1919.

[95] Lead and Zinc in Southwest Wisconsin, op. cit.

[96] "History and Guide to Mineral Point," op. cit., p. 262.

[97] "History of Mineral Point," Historical Records Survey, Wisconsin State Historical Society (Madison), Series No. 27/4/1, Box No. 225, p. 22.

represented about one third of the state's production. Twenty cars came from outside Wisconsin. Some of the ore was treated for spelter purposes, and then sent on to the New Jersey zinc plant at DePue, Illinois for finishing. But its greatest energy during the period was directed toward the production of zinc oxide.

Marketing the Ore and Concentrates

In the early part of the period the drybone was sent chiefly to the Mineral Point zinc works, although some went to the newly established Lanyon Zinc Oxide and Paint Company at Waukegan, Illinois, and small quantities to the Page and Crouse works in St. Louis. The blende ores were shipped primarily to the smelters in Wenona, Peru and La Salle, Illinois.[98]

Later during the boom period of the early 1900's, a few changes were noted in the disposal of the ores. The bulk of the ores still went to the Mineral Point and Northern Illinois plants. Mineral Point attracted large quantities of drybone and low quality blende ores. The Illinois Zinc Company smelter at Peru and the Mathiessen-Hegeler smelter at La Salle utilized blende. Small quantities also went to plants in Waukegan, Sandoval, and Collinsville, Illinois. New processors of Wisconsin ore and/or concentrates were the Grasselli Chemical Company plant at Clarksburg, West Virginia, constructed in 1904, and smelters at DePue and Danville, Illinois, which opened about 1906. Occasionally small quantities of ore were shipped to the Kansas and Missouri smelters.

At the end of the period local companies and non-local buyers still competed for southwest Wisconsin ores and concentrates. The local companies

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[98] W. P. Blake, "The Mineral Deposits of Southwest Wisconsin," _Transactions of the American Institute of Mining Engineers_, XX (1894), p. 564.

would buy ore with 20% to 40% metallic zinc content for their roasting plants, in addition to what was produced from their own mines. The Mineral Point Zinc Company continued to be the big buyer of local ore. The non-local buyers purchased high grade ores from the mines for their roasters, and also bought the locally roasted ore product for their separating plants. Some of the major buyers from outside the district in the pre-1920 period were: Mathiessen-Hegeler with a smelter at La Salle, Illinois; the Illinois Zinc Company with a smelter at Peru, Illinois; the Grasselli Chemical Company with smelters at New Castle, Indiana, New Castle, Pennsylvania, Clarksburg, West Virginia, and Meadow Brook, West Virginia; and the American Zinc and Chemical Company with a smelter at Langeloth, Pennsylvania.[99]

Transportation

Wagon traffic was still important during the boom period in moving ores, concentrates, and mining materials. The roads were often constructed of mine tailings. In fact, in order to facilitate movement of ores, concentrates or goods the mining companies themselves would sometimes construct roads.

However the main type of transportation in moving ores and concentrates within the district and to smelters outside the district and for bringing fuel and supplies to the mining companies was the railroad. Much of the teaming that was done for the mining companies was to connect mine, mill or roaster with the nearest railroad siding. Fortunately, in spite of the relatively rugged terrain, the area was well-served by rail. Generally speaking most mining camps were near a railroad, thus making

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[99]George, op. cit., 1918, p. 144.

shipping of ores an easy matter. By Joplin standards, however, where almost every mine had a railroad switch, the Wisconsin District mines were relatively inaccessible.[100] A number of mines were a mile or more away from a railroad and had to team their ores to the railroad and bring coal and other supplies back. This was expensive and often difficult as road conditions were not good in the early 1900's. Frequent mention was made in newspapers that hauling was impossible due to the poor road conditions. Railroads were not a total answer to transport and supply problems, for on numerous occasions mines were shut down because trains, blocked by snow, could not deliver coal or gasoline.

The rail network.--The district was afforded a direct line to the smelters in northern Illinois by the Illinois Central Railroad; the Chicago, Burlington and Quincy directly linked the region with the smelters in the St. Louis area. These two main lines were at the edges of the district. The Chicago and Northwestern, Chicago, Milwaukee, and St. Paul and the Mineral Point and Northern reached the most active mining camps and gave them access to the other lines and to Chicago (Map 16).

The rail net within southwest Wisconsin changed little between 1896 and 1920. Additions took place in the southern part of the region at Hazel Green and New Diggings, and in the northern part of the district between Mineral Point and Highland. The Hazel Green branch of Chicago and Northwestern Railroad was completed in October, 1907 and provided a considerable boost to the mining in that area. It followed a stream valley (Bull Branch) which was just east of a major mineral range. The Mills Diggins, the Hoskin's mine and the Kennedy mine, all famous

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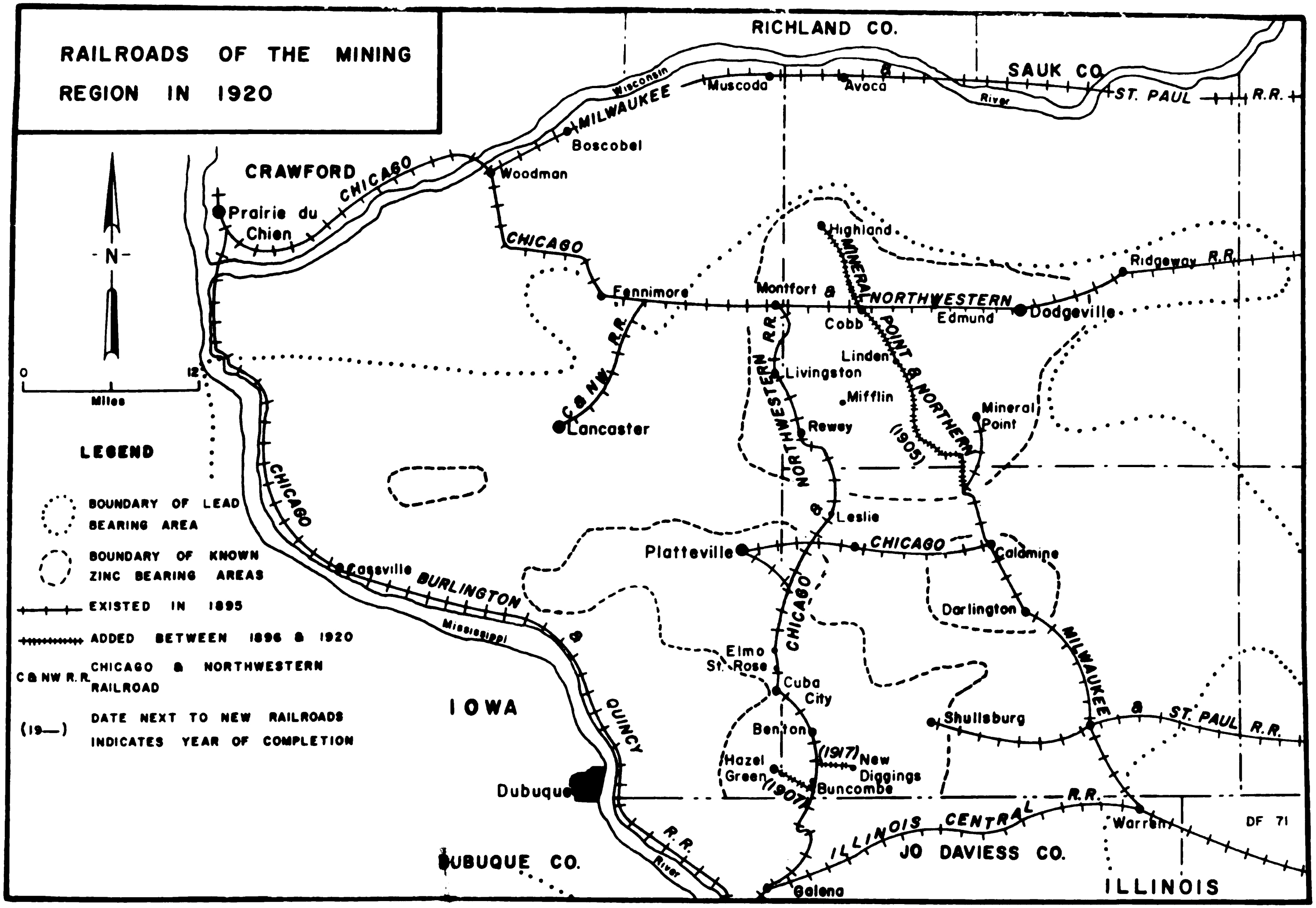
[100]Frank Nicholson, "The Wisconsin Zinc Fields," Engineering and Mining Journal, 76 (December 5, 1903), p. 849.


RAILROADS OF THE MINING REGION IN 1920
N
0
12
Miles
LEGEND
BOUNDARY OF LEAD BEARING AREA
BOUNDARY OF KNOWN ZINC BEARING AREAS
EXISTED IN 1895
ADDED BETWEEN 1896 & 1920
C&NW R.R. CHICAGO & NORTHWESTERN RAILROAD
(19—) DATE NEXT TO NEW RAILROADS INDICATES YEAR OF COMPLETION
RICHLAND CO.
SAUK CO.
CRAWFORD
IOWA
DUBUQUE CO.
JO DAVIESS CO.
ILLINOIS
Wisconsin River
Mississippi
River
CHICAGO MILWAUKEE & ST. PAUL R.R.
CHICAGO BURLINGTON & QUINCY R.R.
CHICAGO & NORTHWESTERN R.R.
C&NW R.R.
MINERAL POINT & NORTHERN
(1905)
ILLINOIS CENTRAL R.R.
(1917)
(1907)
Prairie du Chien
Woodman
Boscobel
Muscoda
Avoca
Fennimore
Lancaster
Cassville
Highland
Montfort
Cobb
Edmund
Dodgeville
Ridgeway
Linden
Livingston
Mifflin
Mineral Point
Rewey
Leslie
Platteville
Calamine
Darlington
Elmo
St. Rose
Cuba City
Benton
Hazel Green
New Diggings
Buncombe
Shullsburg
Dubuque
Galena
Warren
DF 71

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producers, were served by the branch line. This branch was built in cooperation with the mine owners, for the mining companies were responsible for half of the grading costs.

New Diggings had been without a rail connection, and was unique among the main mining centers of southwest Wisconsin in that regard. Finally, after much controversy between mine owners and the Chicago and Northwestern Railroad, the State Railway Commission ordered the Railroad to construct, and maintain a branch line from Strawbridge to New Diggings.[101] A portion of the construction cost was to be borne by the mining companies. This they were happy to do, because the railroad would save them considerable time and expense in teaming concentrates and supplies over hilly roads between New Diggings and Benton. The work, which included a long tunnel through a hill east of Strawbridge, was to have been completed by October, 1917.

Mineral Point and Northern Railroad.--One major addition to the area's rail net between 1896 and 1920 was the Mineral Point and Northern Railroad. For many years there had been talk of a railroad to link Mineral Point and the mining region to its west and north. In 1899 the Mineral Point and Northern Railroad Company was incorporated to build a road from Mineral Point through Linden to Highland. The northern fields were large producers of zinc ore, especially drybone and it would be advantageous to both the mining districts and Mineral Point to have such a railroad. In the 1890's it was common to see teams laden with ore taking their loads from these fields northward to Avoca or Cobb which were then the closest railroad stations. The proposed railroad would get ore to Mineral Point more quickly and cheaply.

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[101] U. S. Geological Survey, Mineral Resources, op. cit., 1916, p. 149.

The venture was at a standstill until 1903 when different leadership was placed in charge of the operation. The railroad was officially opened in January 1, 1905. The close association between the Mineral Point zinc works and the drybone mines in the Highland area, soon led the Mineral Point Zinc Company to acquire control of the new railroad.

The route of the road was not direct between Mineral Point and Linden. It went south from the city of Mineral Point, using the existing tracks of the Chicago, Milwaukee, and St. Paul Railroad for four miles and then at Highland Junction sharply turned northwest following the east branch of the Pecatonica River for most of the way until Linden was reached (Map 16). A more direct northwest route to Linden was too expensive because of the rugged terrain west and north of Mineral Point.

The railroad did a thriving business. Though built primarily by and for the mining interests, it served to promote agriculture as well. Cattle feeders, in particular, made much use of the road, bringing feeder calves in on it and shipping fattened cattle out. Passenger traffic was also considerable and stations were located at Harker, Linden and Highland, in addition to the one in Mineral Point.

Even so, the railroad company was in frequent financial difficulty. Maintainence, wrecks, the competition from autos, and finally the depression of the zinc industry in 1920 proved costly. By the end of the period it was a fast declining operation.

Platteville rail connections.--Much planning was done in an attempt to give Platteville rail connections with the region to her southwest. An electric railroad was proposed to connect Platteville and East Dubuque in the early 1900's and it was to touch many of the mines southwest of Platteville. Although the survey was begun in 1903,[102] and considerable attention was given to the proposed road, it never materialized. Platteville's railroad connections remained to the north, east and south.

The Miners

A final aspect of the nature of the industry to be considered during the period was the "miner" - and all the people connected with the zinc industry. The number of workers increased rapidly during the period, in spite of increased mechanization. The number of jobs also grew in number as specialization of labor came upon the scene. One of the most interesting and unique characteristics of the zinc industry of southwest Wisconsin was the foreign worker element which was present during the period under study.

Number of workers

In 1902, just before the boom began, Wisconsin had fewer than 500 persons employed in the lead-zinc industry (Figure 22). This number placed Wisconsin second among the states, although Missouri, where the Joplin lead-zinc district was already well established, was far out in front with over 6,000 wage earners in the industry. In that same year Illinois had 131 lead-zinc industry workers (some of whom were in the southern Illinois zinc fields) and Iowa had only seventeen. These latter data illustrate further the dominance Wisconsin had in the Tri-State lead-zinc industry.

As expansion in mining development took place production increased and industry employment exploded. In 1909 over 1,900 lead-zinc workers were in southwest Wisconsin, enabling the state to retain second place

[102] Grant County Witness, April 22, 1903.

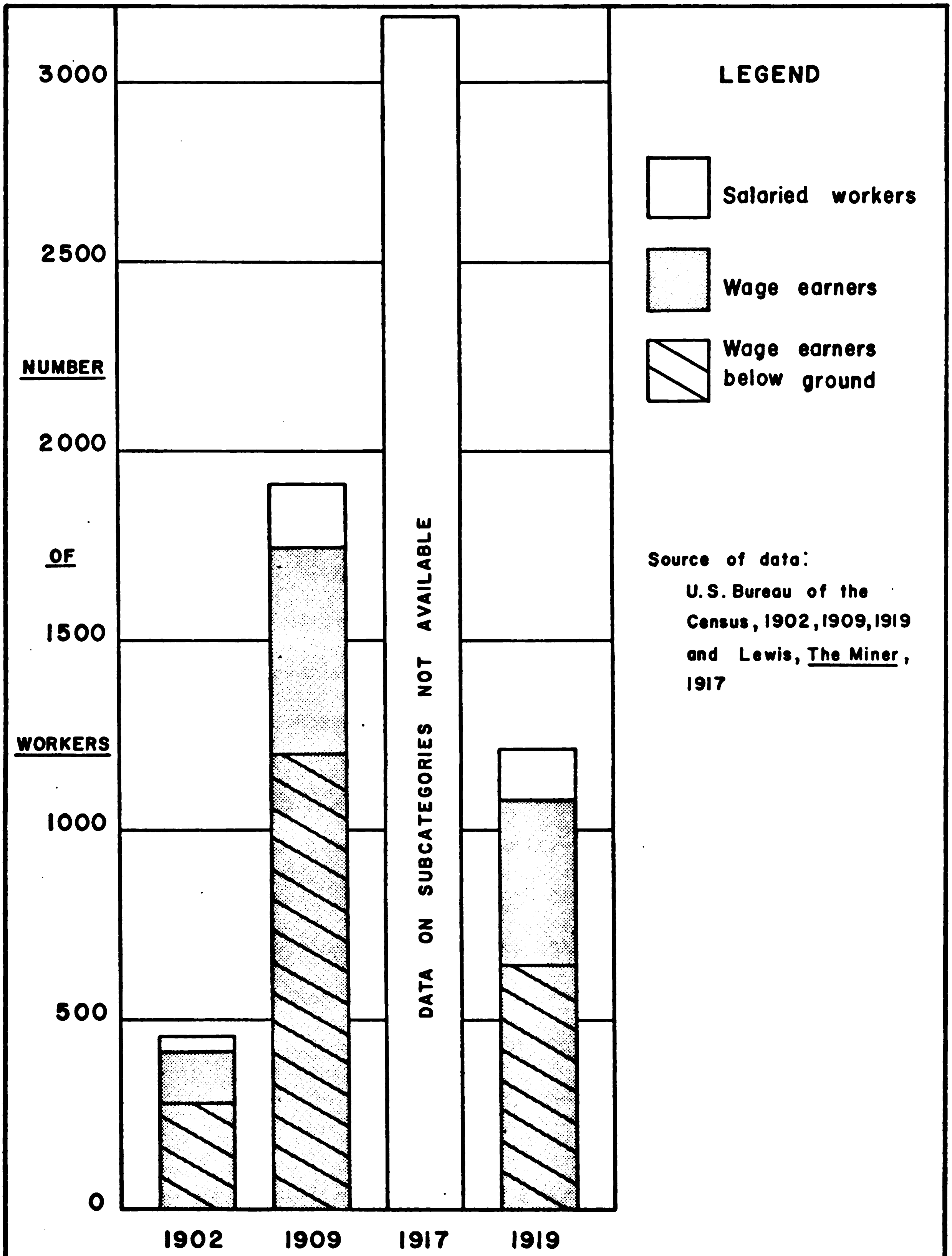

FIGURE 22.
WORKERS ENGAGED IN THE WISCONSIN MINING INDUSTRY

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nationally in employment figures. Missouri, still ranked number one, had 16,319 employed. Peak employment was reached during the late World War I period. It was estimated that 3,176 persons were engaged in the mining industry of southwest Wisconsin in 1917.[103] One source, not contemporary with the time, estimated that the booming war years provided employment "for some five thousand workers,"[104] but this author could find no evidence to support such a figure.

With the closing of the prosperous era came a decline in employment. Twelve hundred workers were engaged in the lead-zinc industry of the region in 1919, ranking Wisconsin third among the states behind Oklahoma and Missouri. It is interesting to note that although production was decreasing at this time it was not decreasing as rapidly as employment numbers. Because of improved and less selective mining methods, the out put per miner was increasing. Thus with fewer workers employed the district's production was higher in 1919 than in 1909.

Jobs in the mining industry

After 1900 the zinc industry usually provided full time occupations for its employees. This was a major change from the earlier mining periods when part time mining was common. Also with the growing size of the operations, specialization of labor increased creating a variety of opportunities for job seekers. There were two main groups of zinc industry wrokers, salaried (8-11% of the total work force) and wage earners.

In the early part of the period those on salary included managers,

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[103] The Miner, 1917, op. cit.

[104] "History and Guide to Mineral Point," op. cit.

superintendents, foremen above and below ground, and surveyors. By 1910, when mining costs had begun to attain considerable size, and continuing throughout the remainder of the period, the nature of salaried personnel changed. There were salaried proprietors (many of whom performed manual labor in the mining operation), corporation officials, superintendents, managers, technical employees and clerks. Foremen were no longer salaried workers.

Some wage earners worked above ground as engineers, firemen, machinists, carpenters and blacksmiths. Below ground wage earners were the miners, miner's helpers, muckers, trammers, and some engineers, firemen and mechanics. In 1902 about 70% of the wage earners worked below ground, but this figure decreased to 68% in 1909 and to 57% in 1919 due to the increased mechanization of underground tasks.

Usually when a man accepted a job at a mine he would stay until the mine closed. There was little shifting from mine to mine, seeking higher wages or better working conditions. Even if a mine closed temporarily the men might either find a part time job or go on relief, but would return to the mine when it reopened. When a mine closed permanently most of its employees would move on to another mine, of the same company if possible. The cycle of a man moving from a closed mine to a newly opened one repeated itself many times, indicating the preference for mining which the men had. A frequently heard saying in the district was, once a miner always a miner.

Wages

One of the biggest attractions of working for a mining company was the pay. Wages were usually higher than those paid for similar or even

more highly skilled jobs in non-mining occupations.[105] Although the pay was not as high in absolute terms as in the Joplin or Rocky Mountain metal mining districts, living costs were lower in Wisconsin and the jobs were steadier.[106]

Wages were usually based on the daily shift of nine hours for the underground worker and nine or ten hours for the surface employee. The work week for most employees was six days, but for some it was seven. In 1902 underground miners received $1.00 to $2.24 per day, with the majority getting between $1.50 and $1.74.[107] The average daily wage in the Joplin mines at that time was $2.00.[108] By 1918 miners' wages in southwest Wisconsin had increased to $3.00 to $5.00 per day.

In 1918 on the surface hoistmen were paid $2.50 to $3.00 per day, grizzly men and crusher feeders $2.75 per day. At the same time monthly salaries for millmen were $90 to $150, mine superintendants $100 to $250, geologists and mining engineers $150 to $250, and office employees $75 to $250.

A job paid for on a contract basis was tramming. Trammers were paid seven to twelve cents for each 1,000 pound car which they filled with ore and transported to the shaft. Hard working trammers could earn between $3-5 per day, and in some exceptional cases up to $9 per day. Non-contract trammers received $3 per day.[109]

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[105] The Exponent (Platteville, Wisconsin), March 1, 1966.

[106] Wright, op. cit., p. 34.

[107] U. S. Bureau of the Census, op. cit., 1902.

[108] Nicholson, op. cit., p. 849.

[109] "History and Guide to Mineral Point," op. cit., p. 259; and The Miner, op. cit., 1917.

Working conditions

The relationships between labor and management were generally good. There were no unions and no written contracts. A laborer was hired by word of mouth agreement, and was retained or fired on the basis of the superintendent's evaluation of him and his work. Usually the labor was dependable, and since the superintendents in the larger companies were careful about who they hired in the first place, firings were infrequent.

There was very little discontent among the miners. They were generally glad to have steady jobs at a favorable rate of pay. Occasionally there were labor-management disturbances in the form of strikes. These were usually in demand of higher wages or shorter hours, and generally were against the smaller companies who had fallen behind others in improving wages and hours for their men.[110]

Wetness of the mines.--The biggest problem in the mines was the wetness. Even with the use of many large pumps, which were necessary to keep the ground water from flooding the mines, the roofs still generally dripped water. At times the roof would leak so badly that it became necessary to put up a temporary roof of sheepskin until the workers got beyond that particular place. In one instance the water pressure beneath the mine was so great that the floor of the working area was forced up. It was common practice for the underground workers to wear rubber boots and sometimes rubber slickers to counteract the wetness.

Although there is no concrete evidence to substantiate it, the

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[110]Data from interviews with A. W. Kopp, op. cit., Jack Trewartha, retired mining engineer and mine superintendent, April 13, 1966; Ed Sawbridge, retired secretary of Vinegar Hill Mining Co., February 21, 1966; and tape of interview with Lester Beecher, retired miner, available at Wisconsin State Historical Society.

writer believes, from interviews with mining industry employees, that arthritic conditions were common among the miners, and this was caused by, or at least heightened by, the wetness of the mines. More than one worker quit the mines permanently because of the wetness. Still, the wetness of the Wisconsin mines gave them an advantage over those of many other mining districts, including Joplin, from another health standpoint. It reduced dust production and accumulation associated with drilling, blasting and other mining activities and thus lung trouble resulting from the inhalation of the dust particles over a period of time generally was absent among Wisconsin miners.[111]

Other positive factors contributing to relatively healthful conditions in the Wisconsin district were the relatively shallow depth of the mines, the lack of injurious gases such as those found in coal mines, and the good ventilation. Fans were used whenever necessary to blow fresh air through the working, where natural ventilation was insufficient or could not be utilized.

Accidents.--The causes of accidents in the district were numerous, but more than half of the fatalities and serious injuries were the result of rock falls from the ceiling of the working level. Still, considering the number of mine drifts, there were relatively few accidents of this type compared to other mining areas. Other accidents were explosions and falls down shafts. A dangerous practice, used frequently, was tamping the dynamite charge with a steel bar instead of wood, sometimes creating sparks resulting in an explosion. The increased amount and more complicated machinery used in the mining operation, both above and below the ground, also resulted in more and different accidents than

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[111] Trewartha, *op. cit.* and Wright, *op. cit.*, p. 37.

in previous periods of study.

Worker's benefits.--At first the mining companies provided little if anything in the way of benefits for workers, other than an opportunity to make an honest living. There were two holidays during the working year, Christmas and the Fourth of July, but the men were not paid for these days. If a man could not work because of illness or any other reason, he lost his wages for the time off the job, and sometimes his co-workers had to make up for his absence. In the early part of the period there was no medical insurance or workmen's compensation.

The companies offered no lodging facilities for the man away from home or the man with a family. It was reported in 1903 that one G. Carroll of Benton "was at Platteville looking at the mines. He says the work is plentiful there, but there is lots of water to contend with, and the mine owners do not furnish sleeping cots, so he came home without taking a job."[112]

By the latter part of the period many changes for the better had taken place.[113] Companies built houses for workers to rent, injuries in the mines were cared for at company expense, and many of the mines had change houses with individual lockers for the men. Although these latter facilities were small and simple, they served the purpose of allowing the miners' clothes to dry after each shift.

An incident in 1918 serves to show the attitude of management toward the miner's health. In the latter part of that year there was a severe outbreak of influenza in southwest Wisconsin. Whole mining

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[112] Grant County Witness, September 2, 1903.

[113] A Workmen's Compensation Act had been passed in Wisconsin in 1911.

crews were put out of commission and many miners, among others, succumbed to the disease. The mining industry management was very solicitous in the treatment of the miners. The best medical aid that could be summoned was provided and the men were cared for at the employer's expense. Hospital treatment was provided for those who required it.[114]

Technical training for the miners

Before 1890 most mining had been done at or near the surface. As non-selective mining became more and more common it was apparent that new skills would have to be taught to the corps of miners already in the district. This was because "the best workers rated as experienced men in shallow mines proved little better than inexperienced men when it came to the deeper work."[115] Thus, the mine operators found it necessary to undertake programs of training their men in new mining methods. Much of this was accomplished through on-the-job education. Another type of program which aided somewhat in the securing of a labor force with up-to-date training, was provided by the Wisconsin Mining Trade School.

The Wisconsin Mining School.--A call for a state mining school had been made as early as 1854 when E. Daniels, State Geologist, suggested that a Department of Mines, similar to the School of Mines in Great Britain, should be connected with the State University to provide a place where the scientific knowledge necessary for successful mining could be obtained.[116] Mining men of southwest Wisconsin continued to voice this

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[114] Platteville Journal, January 1, 1919.

[115] J. Gregory, Southwest Wisconsin - A History of Old Crawford County (Chicago: S. J. Clarke Publishing Co., 1932), p. 448.

[116] Daniels, op. cit., 1854, p. 48.

desire, but were not satisfied when a Department of Mining and Metallurgy was established at the University of Wisconsin in 1871. Although attempts were made in 1889 and 1893 to obtain a separate school of mining, as had been done in Missouri, Michigan, and Colorado, both were unsuccessful.

By the early 1900's the rejuvenation of the mining industry in southwest Wisconsin was sufficiently underway to encourage still another request for a state mining school to be located in the zinc district. This time the proposal was successful and in 1907 the Wisconsin Mining Trade School was located in the city of Platteville. Its program was designed to give students a practical knowledge of mining in a short period of time; its purpose was to train technicians and not engineers.

The school accepted its first students in January, 1908. The school year began in January in order to have the two year course of study include two summers of practical experience working in mines.[117] The regular course of study included geology, mineralogy, chemistry, assaying, mining and mineral surveying, natural science and mathematics. In addition evening classes, presumably for mining company employees, were held on subjects such as mining machinery and hygiene.[118]

Although many of the students who completed the study program at the school did take jobs in the local mining industry, the school never made the hoped-for significant contribution to a trained labor force in terms of large numbers of men. There were only eleven students in the first class and enrollments grew very slowly. Still the school contributed to the area's mining activities in other ways.

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[117] Platteville Witness and Mining Times, December 26, 1906.

[118] Ibid.

Sources of labor

Most of the people engaged in the Wisconsin zinc industry between 1895 and 1920 were from the local area. Some were descendants of Cornish or other early lead miners, and had mining in their blood. Others were former clerks, laborers, or farmers who were attracted by the mining industry's high wages. Many were encouraged to come into the industry by friends or relatives who were already in mining. Because of the rapid expansion of the industry in the early 1900's however, local workers were insufficient to fill the company's needs. Then too, during the war years, the draft system contributed to the labor shortages.

In 1904 the Dodgeville Sun proclaimed: "All mines in Iowa County are working to the full extent excepting they are shorthanded for help. Every mine is ready to put on an increase of experienced men, provided they could just find some to be hired."[119] The situation became more acute in 1906-1907 when the first boom really got under way. A Platteville newspaper headline echoed the industry's need: "There is work for thousands in the district - lots of it and wages are good"[120] and ". . . hundreds of propositions are idle in the district for lack of laborers to work them: encourage labor to come."[121] A major shortage of unskilled laborers, especially shovelers, was noted but also skilled miners, superintendents, and managers were in demand.

Some of the larger companies were especially hard hit, and their labor agents were driven to wits end trying to keep the shifts fully manned. Even the establishment of a federal government employment

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[119]"History and Guide to Mineral Point," op. cit., p. 247.

[120]Platteville Witness and Mining Times, December 26, 1906.

[121]Ibid., January 2, 1907.

agency in Benton in late 1918 did little to afford relief. The United States Geological Survey reported continuing labor shortages in the Wisconsin district were a limiting factor in production during the later part of the period.[122]

These labor shortages resulted in the hiring of large numbers of non-local workers by southwest Wisconsin mining companies. Although this did not solve the labor problem it did significantly change the area mining scene. The non-locals could be classified into two groups: (1) Americans, from other parts of the United States, and (2) foreigners, who came from other parts of the United States or directly from abroad.

American miners.--Non-local American miners came mostly from Missouri, Kentucky and Tennessee metal mining regions. Many were married and brought their families to southwest Wisconsin. It is estimated these men, concentrated in the southern part of the district, comprised a maximum of 15% of the mining labor force during the boom years.[123] After the Wisconsin boom was over most of them moved on to other mining regions.

Another group of non-local Americans who worked in the southern part of the district were Negroes brought from Chicago by a few of the larger companies. Unlike the first group, these men were single, or if married did not bring their families along. Although there had previously been evidence of prejudice toward black men in the area, there apparently was little if any resentment shown toward these miners.

The "foreigners".--The second and large group of non-local workers, the foreigners, represented a wide range of countries. During the period

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[122] U. S. Geological Survey, Mineral Resources, op. cit., 1916, 1917, 1918, 1919 and 1920.

[123] Interview with Lavern Newman, son of a former miner, April 29, 1966.

being studied the following groups were found in southwest Wisconsin (the names are those used by contemporary observers): Scandinavian, Finns, Mexicans, Armenians, Turks, Macedonians, Bulgarians, Serbs, Rumanians, Montenegrans, Poles, Old Russians, and Lithuanians. Although Latin America and many parts of Europe were represented, persons from eastern and southern Europe were in the vast majority. The Bulgarians and Poles were found in the largest numbers and in all parts of the Wisconsin district. It is estimated that during the prosperous World War I years, the foreign element accounted for about 30% of the mining labor force.[124]

The foreign element was made up of both married and single men, but the married men rarely had their families with them. Most of these people had come to southwest Wisconsin to earn money and not to stay here permanently. Many sent money home regularly and others were saving money to take home with them. Still others were saving money to bring their families to this country.

The foreign labor was recruited primarily for shoveling in the mines, although a few eventually became skilled miners. In general the immigrants were reliable and performed their tasks satisfactorily. They were likely to stay at one mine or with one company until it shut down its operation. Some Bulgarians stayed with the same companies for over thirty years.[125] After the heyday of Wisconsin zinc mining many of the foreign workers left the local area for jobs in the Chicago - Gary steel mills, or in mines in other parts of the nation, while still others returned to their homeland.[126]

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[124] Ibid.

[125] Sawbridge, op. cit.

[126] Interview with Milton Longhorn, born and raised in New Diggings area. April 29, 1966.

Many of the migrants did not speak English before they arrived, but after being here for a while were able to converse slightly in the new language. The United States Bureau of Mines was aware of the language barrier and published safety circulars in Polish and Slavic, as well as in English.[127] The latter also indicates the predominance of east Europeans among the foreign element.

The language and religious differences between the foreign laborers, coupled with strong nationalistic feelings, resulted in their staying in rather distinct ethnic groups. A colored neck scarf was usually worn to signify the wearer's nationality. The groups generally got along well with each other, but there were times when physical conflicts erupted resulting in injury and sometimes death. It is said that sometimes the Balkan Wars were re-fought in southwest Wisconsin.[128]

The local people generally were indifferent to the immigrants or passively accepted their existence. There was little if any outward prejudice shown. Like the Negroes, these people were able to use all facilities in the towns and could buy in any store as long as they had sufficient funds.

Relationships between the foreign workers and the mining companies were good. Each group of foreign laborers would have its own leader and he would negotiate with the management for his band. Occasional strikes by these groups, usually for higher wages, were reported, but were settled amicably. One source of consternation to the companies was the difficult names of the immigrants. Thus, frequently, these workers were given new and simple "American" names, which many migrants adopted as

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[127] Platteville Journal, March 28, 1917.

[128] Longhorn, op. cit.

their official names while they were in this country.

Virtually nothing remains in southwest Wisconsin today to attest to the contribution of these groups to the zinc industry or to the area. Indeed little evidence is found of their very existence. A few written records and the dimming memories of aging local residents who remember them is all that remains, with one major exception - the Italian colony in Mineral Point.

Two Italians who worked for a Wisconsin railroad, heard in 1903, about high paying job opportunities at the Mineral Point zinc works. They obtained jobs there and soon sent for their families and other relatives. Before long a sizeable Italian community had been established on the south side of the town, just west of the zinc works. There they established their old world customs and food specialties. Unlike the other foreign groups who came to southwest Wisconsin, the Italians stayed after their jobs in the zinc industry were completed, finding new work in farming or other economic pursuits. Their colony remains in Mineral Point today.

Settlement patterns

Many of the mines were close to already established towns, thus most miners maintained a residence in town and walked or rode to the mine. Platteville, Mineral Point, Dodgeville, Shullsburg, Hazel Green, Benton and numerous small towns all had miner residents. Sometimes if a mine closed and the miner went to a new mine in a different locality, he would move his family to the closest town. In numerous cases, however he would simply take a room in the new town and return to his family residence only on weekends.[129]

[129] Kopp, Trewartha, op. cit.

As the mining prospered, more miners came to the district and housing shortages arose. Local newspapers urged area capitalists to invest in housing facilities, for their own benefit and also to aid the mining industry.

Eventually the mining companies themselves had to solve the housing problem. Because not only were insufficient numbers of housing units being built in the towns, but also several new mining operations were being conducted at considerable distance from the major towns. Thus beginning in about 1910, the larger companies such as Vinegar Hill, Wisconsin Zinc, and New Jersey Zinc built bunkhouses, boarding houses, and small houses called bungalows for their employees.

The bunkhouses existed in large numbers in the area, some mines having as many as thirty to forty around them. These shack-like dwellings were built primarily for the foreign laborers and housed five to ten men. Although used mainly as sleeping quarters, some of the immigrants also cooked meals in these houses.

The two to three story boarding houses were used as sleeping quarters for twenty to forty men and also served meals to resident and non-resident miners (Figure 23). A reasonable charge of about seventy-five cents per day was charged for room and board.[130] Individuals or married couples were hired by the mining companies to operate these houses. These houses were not only important for housing miners and serving meals, but they also acted as food supply centers for the bunkhouses and company cottages. Some mines with especially large work forces were supported by two or three boarding houses. In these cases one boarding house might be used for one foreign nationality group, a second house for a different

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[130] Beecher, op. cit.

Figure 23. Mine boarding house scene. Boarding houses were located primarily next to large mines in the southern part of the district.

Figure 24. Miner's cottage. One of the many small worker's homes that was located at Cokerville. Four small rooms were common in these structures. After the mines closed the cottages were either torn down or moved to other mines or farms. This house, vacant today, is located on the farm of M.Schambow north of Rewey.

group and so on.

Small cottages were built at a few of the larger mines away from towns, for miners with families. Some of these were fairly large - six rooms with bath, and were rented to superintendents, millmen or ground bosses. More commonly, however, they were simple, four room dwellings with no inside plumbing, for the common miner or laborer (Figure 24). Rent was nominal at about $5 per month.[131]

Although numerous mines had, in their vicinity, these types of accomodations, there was only one sizeable village made up solely of these types of dwellings. That was Cokerville, which grew up around the Coker mines. Stringtown, as it was also called in 1911 when it was begun by the New Jersey Zinc Company, had four houses at a crossroads; one road leading to the famous Coker mines, one fourth of a mile east of the intersection, and the other road going south to the nearby village of Rewey. One structure was a boarding house, another housed the superintendent, the third was used by the mine mechanic, and the fourth was available for rent by a miner. During the next several years as more families arrived, the company built additional houses until a maximum of forty-five to fifty bungalows, occupied by English speaking miners with their families, were strung out along the roadways for one half to three quarters of a mile. Shack-like bunk houses grew up in the immediate vicinity of the mine and were occupied by foreign miners.

These living facilities were important parts of the mining landscape during the World War I era. They were important to the mining companys, too, for when a mine worked out, the better houses were often moved to a new mine location by the company. In fact, to facilitate such moves, many of

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[131] Ibid.

the structures were built in sections. Some of the best houses from mine locations were eventually moved to farms and became farm homes, while smaller ones were purchased by farmers for use as chicken coops, sheds, and so forth. The poorest shacks were either left standing for the elements to destroy, or sometimes torn down for scrap lumber.

The End of a Prosperous Era

The Wisconsin zinc industry began to decline in 1918 as a result of higher costs of production cutting deeply into the margin of profit. Prices fell steadily after a high of $135 per ton had been reached in 1918. In 1919 60% zinc ore brought $60 per ton and in the fall of 1920 less than $30 per ton. Many mines closed down. In 1916 there had been eighty mines shipping ore, but by 1919 due to the adverse operating conditions the number was down to less than thirty.[132] The Coker mine, longtime symbol of zinc mining in the area, suffered so much from the hard times that it was shut down completely in the fall of 1920. It was the first time in thirty years that this had happened. The mules were brought up from below and about 250 men were out of work. This was a great blow - particularly to the Livingston area - but similar events were taking place throughout the district. Zinc metal production dropped from the peak of 59,742 short tons in 1917 to 40,765 in 1919 and 27,285 in 1920. (It plummetted to 3,390 short tons in 1921!) In 1920 the zinc industry of southwest Wisconsin was in the midst of the severest depression it had ever faced.

Although the mining industry was plagued with a variety of ills in 1920 its leaders and area residents had experienced hard times in

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[132] Boericke, op. cit., p. 1216.

the past. Thus they were optimistic that the future would bring better conditions to southwest Wisconsin's mining industry and to the area in general. They could not know however, that although the depression in which they then found themselves would soon end and the mining industry would indeed again prosper, the days of mining being a major economic factor in the region were gone. The mining industry with its national significance and its importance to the economic well-being of the area, and its prominence on the natural landscape was a thing of the past.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The purpose of this dissertation has been to describe and assess the changing character of the mining industry in southwest Wisconsin between 1820 and 1920, along with its impact upon the region's geography.

Southwest Wisconsin achieved national prominence between 1820 and 1920 on the basis of its mining industry. Although sometimes characterized as a backward mining region, it was the nation's leading supplier of lead during the 1840's and made substantial contributions to the war effort in the 1860's through its lead production. Zinc production was also nationally recognized. From 1903 until 1920 Wisconsin never ranked below fifth in national zinc production and rose to as high as third. Locally the industry was instrumental in the area's initial economic development and played a major (though not continuous) role in its further settlement, and cultural composition. During the time span of one century, examined in this work, the character of the mining industry changed markedly.

A Changing Industry

A great change was the shift from lead to zinc, as the primary object of the miner's search. In the beginning, easily mined and high quality surface lead deposits were sought. As long as lead was readily available no zinc was mined, even after lead pits and shallow lead mine shafts reached zinc bearing horizons. After the shallow lead deposits were depleted however, zinc ore became more and more significant until finally zinc surpassed lead in tonnage produced in the 1860's. Later, the total value of zinc mined was greater than that of lead because of the overwhelming dominance zinc had in production figures. Also there was a change in the importance of the area's two zinc ores. At first smithsonite was the major zinc mineral, but this was quickly surpassed in importance by sphalerite.

As the emphasis switched from lead to zinc, differences in mining organization and mining techniques occurred too. In the early lead mining days, ore was profitably taken by the individual miner or by small companies of two or three men, with little capital investment. Gradually, as mining became deeper and more complex, a need for large capital investment was realized. This brought about the creation of small locally owned stock companies, several of which continued to grow and by 1920 had become affiliated with giant national corporations. Although there was a definite shift to larger and larger companies and a trend toward the corporate form of organization, throughout the entire period of study the area was marked by the persistence of the primitive mini-company - two, four, or six men operating on a shoestring basis. This latter characteristic was one of several which gave the region a national reputation as being backward in its mining activity.

Mining operations were at first very primitive. Shovels and picks were the primary tools used during the early years to remove the ore from surface pits. Then shallow and narrow shafts and tunnels were dug to reach the deeper lead deposits and drybone ores. The techniques of the industry changed slowly, even when the emphasis switched from lead to zinc. Shaft sinking was the primary means of exploration until the 1900's. Hand drilling, the use of common black powder, and hand shoveling, all characterized the operation of mining the ore during most of the study period. The ore was removed from the mine by loading it into wooden tubs which were taken by mules, horses, or men to the shaft bottom and then hoisted to the surface by hand or a horsepowered windlass. Mine drainage, often a serious problem, was inefficiently cared for by bailing with tubs or by construction of adits. As a general indication of the state of the mining operations, until the beginning of the twentieth century horses and men were the main sources of power in the mines.

In the early 1900's it became necessary to go deeper (below the water table) to find useable zinc ores. This necessitated creation of larger companies, with large sums of money available for investment. A major change in mining activity came about with the deeper mining and the operations of the large companies - namely a shift from selective to non-selective mining techniques. Consequently mining was conducted on a larger scale, and there was a slow but sure modernization of many mine operations. Most of these improvements occurred in the early 1900's.

Drilling, especially churn drilling, became the principal method of prospecting. Other improvements such as supervised drilling, the keeping of accurate records, and assaying of the ore, became associated with exploratory practices. Although shaft sinking continued to be the major means of opening mines, shafts were wider, deeper (average depth in 1907 was 150 feet) and better constructed, and there were frequently multiple shafts in use at a single mine. Better and more powerful drills were being used underground as were more potent and safer explosives.

Hand loading and tramming were common even during the early 1900's, but by the World War I period mechanization was modernizing these tasks along with that of hoisting. Water was still a serious problem, but with large and adequate pumps it could be kept under control. Although men and horses were still used as major power sources in some mines as late as World War I, by 1914 electricity supplied by Galena and Mineral Point firms was the main source of power throughout the district.

The method for disposal of the ore, once it had reached the surface, changed during the study period. Lead ore had always been taken to one of the many furnaces that dotted the region and was easily reduced. It was then sent out of the region in its final form as pigs of lead (lead bars). Zinc on the other hand was a more complex ore and necessitated a different and more complicated processing. The first step was crude "hand picking" (breaking the rock with a sledge hammer) followed by hand jigging (water separation of mineral from gangue on the basis of differences in specific gravity). Drybone ore was then roasted and manufactured into zinc oxide, usually at the Mineral Point zinc works, before being shipped out of the region. The blende ore, on the other hand, was shipped out of the region to nearby smelters immediately after it had been jigged.

Modernization of the area's mining, which was taking place in the early 1900's, was also extended to the processing aspect of the industry. Mills were built which through mechanization and improved methods, made the initial crushing and jigging processes more efficient. A major breakthrough in processing however, was in the discovery of the technique of roasting and magnetic separation. Prior to this development much of the area's ore was very difficult to separate by the jigging process because of the intimate mixture of iron sulphide (pyrite-marcasite) and the blende. Also, very often the product of the jig mills was not acceptable at zinc smelters because of the too high iron content. Thus, the development of the roasting-magnetic separation process in southwest Wisconsin was a great aid to the industry, giving it new life. This process yielded a richer product than previously available and also allowed the companies to utilize leaner ores than in the past.

Still another aspect of significant change in the industry involved the mining labor force. Mining was a part-time activity during the Lead Era. It was a common occurrence to find the same men engaged in mining during the winter and farming in the summer. As late as the 1880's, mining work on the average lasted only 120-190 days out of the year. There was little differentiation between the workers in the early days - the two main groups being miners and laborers. Hours were long and working conditions were poor.

After 1900 mining was a full-time job for most miners and specialization of jobs was common. Also a distinction was made between salaried workers and wage earners. Working conditions improved markedly. Because of the rapidly expanding nature of the industry in the 1900's, labor shortages were frequent. As a result mine owners and managers hired workers from other parts of the United States, and brought in groups of migrant laborers from foreign countries. This was in great contrast to the local origin of most miners after initial settlement, except for the Cornishmen.

After the mining industry further developed, more and more workers became engaged until a peak was reached around 1917. This labor increase took place in spite of the mechanization which was also occurring in the industry. The men were working shorter hours, and did not have to work as hard physically as in previous periods, but the ore production per man continued to increase.

Although many changes have been noted in several aspects of the mining industry during the century examined, one facet - that of location - changed little. In general terms the boundary of the mineralized area was delineated in the early 1800's by the outermost margins of the settled areas in southwest Wisconsin. Then in 1839 Owen delimited the mineralized areas and his boundary still corresponds favorably with the current one. Within this area lead mining was widespread, but zinc mining was concentrated in only a few districts. The major change in the location of lead mining was one of a decreasing number of locations after the 1840's; especially since lead became secondary to zinc and was then produced in large part as a by product of the zinc industry. Zinc mining locations did fluctuate within the district from time to time, primarily in terms of prominence. In the early zinc period (1860-1890) Iowa County - particularly the Dodgeville, Mineral Point, Linden, and Mifflin regions, was by far the leading production area. Lafayette County also had significant production in that period, mainly in the west around New Diggings and Benton. Grant County was a poor third. During the early 1900's a few changes took place. The southwest part of Lafayette County rapidly established itself as the major producing area, and the Platteville vicinity came on the scene as an important mining center. Platteville, the largest city of the district also was chosen as the headquarter's for many of the major mining companies. The northern fields, in Iowa County, declined in importance but still continued to produce ore.

Mining and the Physical Environment

Another of the principal objectives of this study has been to describe the inter-relationships between the mining industry and the area's landscape. Noted here are some of the more significant relationships between mining and the human and physical landscapes, both within the region, and between it and other parts of the United States.

The nature of the lead deposits was a major reason for the rapid and successful development of the industry. Available in large quantities and at shallow depths they were easily mined and smelted without large capital investments. Zinc ores were deeper than galena and this in part was responsible for the zinc industry's later start. Although the zinc deposits also were relatively shallow and easily mined and processed, there were disadvantages of the ore deposits too. Being of a rather simple makeup was a drawback, since there were no valuable mineral co-products such as silver, copper, antimony, and bismuth. Many of the western zinc mines had these valuable co-products. Also, the zinc deposits were relatively low in quality, thus contributing to the region functioning as a marginal producer.

Railroads were slow in coming to the area and their routes of travel were strongly influenced by the rugged terrain of the region. This hilly character did allow though for the driving of adits when that method of drainage was desirable. Much more widespread however, was the influence of mining on the landforms. The early surface lead miners dug thousands of pits in all parts of the mining region, and many of the uncultivated parts of the area today still show the pockmarked surface effect of this early activity. Mining resulted in large amounts of rock being removed from underground and caves being created there. Surface depressions and sinkholes have resulted from mine caveins. Then too, the minewater runoff would sometimes channel itself and cut ditches into the surface.

The water element in the mining industry was often closely interwoven with the natural environment. Pumping water out of the mines onto the surface had the effect of lowering the surrounding land's water table. Thus wells near newly opened mines usually had to be dug deeper. When the pumps were stopped the water table would rise again. The mine water runoff often modified the surface in addition to the creation of ditches. Sometimes the water spilled out fan-like from the mine mill and laid down waste sediment ruining the land for agriculture. The waters might increase the volume of the surface streams and thus increase the natural stream's potential for erosion . In the ore separation process a large amount of silt was formed and carried away by water and deposited in the nearest valley, sometimes aggrading it by two or three feet and changing the stream's course. In some cases, where underground water was insufficient for processing, valleys were dammed and surface runoff preserved. This resulted in raising the valley floor above the damsite by preserving silt that otherwise could have been washed away. This also prevented some erosion below the dam by restricting the volume of water to flow through the valley.

Pollution of the environment was a by-product of the mining industry. The concentrating process put pollutants into the air. Most noticeable and severely affecting several areas were the roaster plants. The sulphuric acid released to the air in processing by these plants had a very deleterious effect upon the roaster's surroundings. Also, water leaving the mills sometimes would contain harmful agents and pollute streams and rivers.

Of the major physical landscape components, weather and climate were not strongly related to the mining industry. The hot summers and cold winters had little effect on the actual mining of the ore, since temperature remained constant underground. Surface operations would be carried on all year except sometimes for short periods when temperatures would drop very low, or when there was a heavy snowfall. The moderate rainfall, concentrated in spring and early summer, was not a factor in mining, although sometimes dirt roads connecting mines with towns or railroads did become impassable after heavy rains.

Mining and the Human Environment

Various facets of the economic and settlement patterns of the area were strongly related to the mining industry's development. The necessity of linking mines with nearby towns and smelters was a primary impetus for the establishment of the southwest Wisconsin's road and rail network. The numerous wagon roads built for and by the mining companies served the people and commerce of the area in general. These roads were often constructed and kept in good repair by the utilization of the crushed rock and tailings from the mines.

As mentioned above rail transportation in southwest Wisconsin was hindered by the rugged terrain. Thus the first railroads built westward from Madison did not pass through the heart of the mining region, but sought a more northerly route. The mining men did not take long to make their economic and political influence felt and soon railroads were serving the area. Although the prosperous agriculture of the region had much to do with the construction of railroads, several local railroads were built primarily for the mining industry. Such was the case with the Mineral Point and Northern Railroad. It was developed to give the mining region easy access to the smelters in Illinois; yet this railroad and others like it contributed greatly to the growth of agriculture through the shipping of agricultural produce.

The mining industry made other noteworthy contributions to the economic development of southwest Wisconsin. Data is not available to ascertain the total amount of money gained by the area's economy from mining over the years, but it certainly has been substantial. Wages and salaries paid to the hundreds and sometimes thousands of workers in the mining industry, direct mining company purchases of power, services, and taxes paid to local governments by mining companies - all enriched the region's economy.

Other economic activities were affected by mining. Several local industries were begun directly as a result of mining. Some were small, such as the local brick and block manufacturers that used mine tailings as their raw material. Others grew to national prominence such as the Mineral Point Zinc Company. The latter's plant was of course very much a result of the development of southwest Wisconsin mining activity, but it was also a major reason for the continuing growth of mining - it provided a local outlet for Wisconsin ore and most important was able to utilize much of the area's lean ore production. During the early lead period the major local type of manufacturing industry and the one nationally prominent industry were directly related to mining - these were the numerous lead smelting furnaces and the Helena shot manufacturing tower respectively.

Agriculture and mining were strongly inter-related for many years. The cultural pattern of the part-time miners and part-time farmers lasted well into the zinc period. Farming on a large scale in southwest Wisconsin was delayed due to government restrictions established for the benefit of mining. Agriculture, once established, did prosper because of the demands made upon it to feed the mining population. Of course, still visible on the landscape is the fact that mining removed much of the countryside from agricultural production. Perhaps the most important relationship however, was that although the area's mining was rather unstable in terms of economic prosperity, the region did not suffer during hard times in the mining industry. This was because of the prosperous and well-developed agricultural base.

Mining had a marked effect upon the area's people and its settlements. The earliest settlements were laid out on the basis of the attraction of nearby ore deposits. Towns were found mainly in an irregularly dispersed pattern and closely related to the location of the mineral ranges. Even in later periods a new town would occasionally spring up because of a new mineral discovery. This association worked in reverse too. Towns disappeared from the landscape, or are tiny fragments of former sizes, because of depletion of ores and the exodus of the mining population.

In general as mining prospered so did the towns and cities. Improved or increased transportation routes, larger populations, better wages - these and other factors related to mining, encouraged trade in the towns and helped them grow. Several towns founded on an agricultural base greatly prospered, grew in size and expanded their economic base because of mining development and prosperity. As one booster of the district reported in 1907:

> Not a village in the entire mining belt but already shows the prosperous touch mining has given to the district. Linden, Cuba City, Highland, Benton, and Platteville have led in outward manifestations of prosperity by building

> miles of cement walks, hundreds of new residences and this summer will see a stronger continuation of the magic effect of mining as conducted along modern lines upon all of these communities.[1]

Mining prosperity brought to southwest Wisconsin a business and commercial group of people who were different from the agricultural type already there. These newcomers included capitalists with modern business methods, who set a precedent for businessmen of the region. Business life in general was given a lift.

The labor requirements of the mines had interesting repercussions. Farmer's sons and farm helpers attracted by high mining wages left farm work, creating shortages of farm workers during many periods. As a result, farmers sometimes had to pay laborers exhorbitant wages or else let crops and animals go unattended.

The expansion of mining resulted in an influx of outside laborers to the area. The first major groups were from other parts of the United States; later they came from foreign areas. Cornishmen, east and south Europeans, Latin Americans, all came and created a diversified cultural landscape. Numerous evidences of the Cornish - housetypes, foods, terminology, and even descendants of these early settlers, may still be found. Though the other "foreigners" contributed to a distinctive cultural landscape of southwest Wisconsin in language, dress, foods, customs, and music, little evidence of their former existence remains.

Other elements have been influenced by the mining industry. Politics and government were strongly affected. Lead mining, and the settlement and prosperity accompanying it, was the strongest factor in the attainment of statehood in 1848. The first state capital was

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[1]J. H. Lewis, "History of the Zinc Fields in Southwest Wisconsin - Past, Present and Future," Tri-State Yearbook, 1907, p. 40.

established in the heart of the Lead Region at Old Belmont (called Leslie today). Also much government time and money was spent on study and appraisal of the minerals and activity of mining in southwest Wisconsin.

One other outgrowth of political strength of the mining interests and one that benefitted the region in terms of educational opportunity, was the establishment of the Wisconsin mining school in Platteville. This school was created as a result of the mining industry's pressure and was placed in the heart of the mining area. It served both the area's mining companies and the region's growth in general.

Not all of the inter-relationships between mining and landscape elements were local. The mining activity of southwest Wisconsin was closely tied to national demand and prices for its minerals. Civil War needs gave a big boost to area mining. During the World War I period southwest Wisconsin experienced the greatest mining productivity and prosperity ever known there, due to large demand and high prices. At times of national depression and low mineral prices, the local mining scene was usually bleak too.

Southwest Wisconsin's mining industry was affected by other regions in the United States. The establishment of zinc smelters on the nearby coal fields of north central Illinois was of benefit to Wisconsin. On the other hand the development of the zinc mines in the Joplin area and in the western states produced competition that had a negative effect upon mining in southwest Wisconsin and in large part contributed to the depression of the local industry in 1920.

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