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ACCOUNTING INNOVATIONS: THE IMPLICATIONS OF A FIRM'S RESPONSE TO POST CIVIL WAR MARKET DISRUPTIONS

Abstract: This study addresses the nature of accounting innovations within the context of the Quincy Mining Company's response to the disruption of the domestic copper market following the Civil War. Primary documentation is used to first define the firm's cost management activities, then to define the characteristics of the firm's internal accounting practices that contributed to these activities. It is argued that, although accounting was a participant in the cost control process, it was a paternalistic social structure that provided the impetus for the firm's struggle to remain profitable.

Nineteenth-century accounting existed in an environment lacking uniform practices and professional standards; each system reflected a unique network of economic, social and cultural influences. Even in today's relatively standardized environment

> . . . we have only a limited understanding of the conditions which provide the possibility for the particular conceptions of the accounting craft, the forces that put accounting into motion, the processes accompanying accounting elaboration and diffusion and the varied human organizational and social consequences that can stem from changing accounting regimes [Hopwood, 1987, p. 207].

In recent years an extensive body of research has emerged that addresses the social and cultural aspects of accounting processes [Hopwood, 1987; Hopper, et al, 1987; Dirsmith, 1986; Meyer, 1986; Burchell, et al, 1980]. Others have explored the accounting implications of more specific social constructs such as rituals [Gambling, 1987], creativity [Hood and Koberg, 1991], religion [Hamid, et al, 1993], and ethics [Cohen, et al, 1993]. Of particular relevance to this paper is the literature concerning the

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interaction between management control and social processes [Dent, 1990; Neimark and Tinker, 1986; and Covaleski and Aiken, 1986]. These concepts were operationalized by case studies of organizational and social control processes such as Birnberg and Snodgrass [1988] (a comparison of Japanese and American perceptions of management control systems); Dent [1991] (organizational change in an English railroad); Knights and Collinson [1987] (the disciplinary effects of accounting information and shopfloor culture); and Loft [1986] (early twentieth century cost accounting in the United Kingdom). This paper draws upon, and contributes to, this research by addressing, in an historical context, the nature and causes of accounting innovation.

Johnson and Kaplan [1987] relate the emergence of management accounting practices to the internalization of economic change and the resultant development of large scale firms. From this perspective accounting innovations are directly related to changes in a firm's management information needs. For example, Chandler [1977, p. 109] studied the emergence of management accounting and control practices in the mid-nineteenth century American railroad companies and concluded that, as the organizational structures and operational planning of the railroads became more complex, the need for accurate information led to

> . . . the devising of improved methods for collecting, collating, and analyzing a wide variety of data generated by the day to day operations of the enterprise. Of even more importance it brought a revolution in accounting; more precisely, it contributed substantially to the emergence of accounting out of bookkeeping.

Others [Hines, 1988; Burchell, et al, 1980; Dirsmith, 1986; Hopwood, 1987] would argue that accounting processes, and the forces that drive them, are more complex and reflect a wider array of social and cultural influences. Miller and O'Leary [1990, p. 480] posit:

> Accounting is involved in much more than directly facilitating managerial decisions, indeed its capacity to fulfill such a role and the culturally specific ways in which it is constructed are themselves dependent on particular values and norms invented in specific contexts.

From this perspective an interpretation of accounting innova-

tions must reflect the ways in which accounting interacts with the firm's attempts to define itself and the nexus of relationships that enable the productive processes.

The essence of these perspectives is exemplified by Hoskin and Macve [1988] and Tyson [1990]. While both studies acknowledge that the Springfield armory was able to achieve productivity gains after 1840 as a result of accounting innovations, they disagree as to why these innovations did not occur at an earlier date. Hoskin and Macve [1988, p. 38] contend that accounting innovations, in the form of "the successful integration of piece-rate accounting with a clock-regulated workday, utilizing inspection and incentive schemes", did not occur until an armory superintendent with sufficient knowledge and training was appointed in 1841. In other words, accounting innovations did not occur prior to 1841, even though they were technically feasible, due to the absence of managerial competence. Tyson [1990, p. 50] suggests that other factors, including "skilled labor shortages and labor's resistance to controls, cooperative knowledge and cost sharing among arms makers, and the absence of significant labor decrafting" were more important. From Tyson's perspective accounting innovations were constrained, not by management's ability to use or demand new information, but rather by social and culture norms.

Under the premise that accounting innovations are driven by the need for new management information, which in turn is driven by economic and competitive forces, the Quincy Mining Company's post-war cost reduction program should have resulted in accounting innovations.[1] But there were no significant changes in the firm's internal auditing practices.[2] Apparently the

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[1] There are at least two reasons to expect that accounting innovations may have occurred. First, the Springfield armory experience suggests that productivity and efficiency could have been enhanced by increasing the disciplinary potential of the accounting process. Second, McGaw [1985] found that accounting processes in another 19th century firm were supportive of technological advances. Attempts by the Quincy Mining Company, between 1861 and 1877, to alter the technology of the mining process suggest that accounting innovations may have been required.

[2] This statement is based upon an analysis and review of the accounting system of the Quincy Mining Company between 1846 and 1900. This process included the analysis of all available formal accounting documents such as journals, ledgers, day books, payroll documents, annual reports, and extensive correspondence between tee major stockholders and the mine managers. This documentation is located in the historical archives of the Robert Van Pelt Library at Michigan Technological University.

accounting system was sufficient to satisfy the information requirements of the firm's management. By clarifying the financial position of the Quincy Mining Company between 1861 and 1877, then evaluating the characteristics of the firm's accounting practices that made innovations unnecessary, this study will enhance the knowledge of nineteenth-century accounting processes and may serve to inform the ongoing debate between traditional and critical theorists concerning the basic nature of the accounting phenomena [Merino and Mayper, 1993].

The remainder of this paper will first provide an analysis of financial information from the firm's annual reports that were issued between 1861 and 1877. This analysis is used to define the response of the Quincy managers to a post war disruption of the copper market. Next, the accounting based cost management processes used by the firm are defined and interpreted. Finally it is argued that the absence of accounting innovations between 1861 and 1877 can be explained by the inherent labor control mechanisms of the paternalistic mining community.

DATA ANALYSIS 1861-1877

This section provides an analysis of financial information from the annual reports issued by the Quincy Mining Company between 1861 and 1877 and defines the cost reductions made by the firm after the Civil War.[3] Since the American economic environment was relatively unstable throughout the period being examined, the financial information provided in this analysis is, unless otherwise noted, adjusted to 1860 price levels using a relevant consumer price index.[4]

GROSS EARNINGS

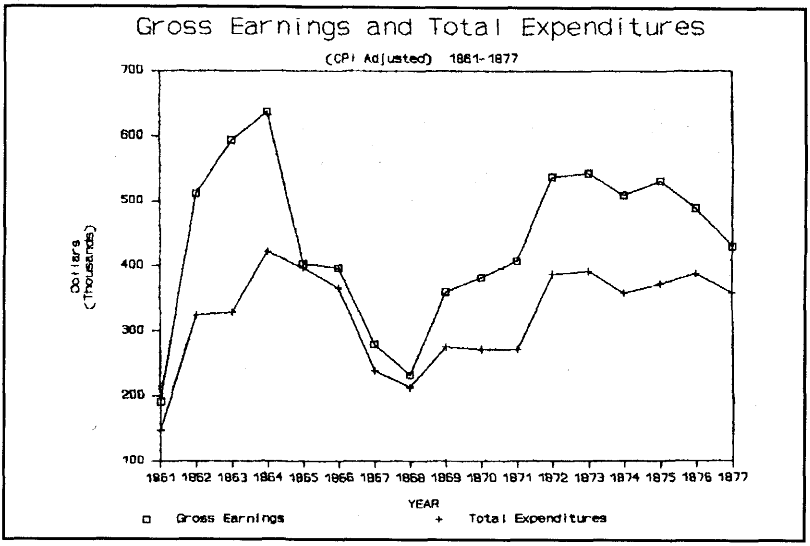
The gross earnings of the Quincy Mining Company increased between 1861 and 1864, then dropped sharply in 1868 to the lowest level in the period between 1861 and 1877 (Figure 1).[5] This pattern can be partially explained by the market price of copper and the volume of production. Figure 2, which shows

[3] The period between 1861 and 1877 was selected because the firm issued its first annual report in 1861 and followed reasonably consistent reporting practices through 1877. In 1878 financial reporting concepts were significantly altered.

[4] U.S. Department of Commerce. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Consumer Price Index (Hoover): 1851 to 1880. Series E 174-182, p. 212 (all items).

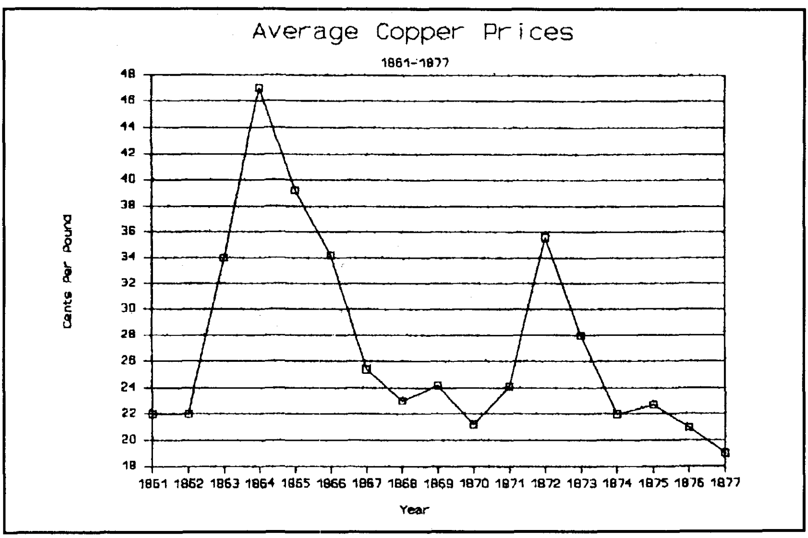
[5] All Figures are presented in Appendix A.

FIGURE 1



the average annual copper prices between 1861 and 1877, reflects a high of $.47 per pound in 1864 followed by a rapid decline to $.23 per pound in 1868, a pattern that roughly coincides with gross earnings.[6]

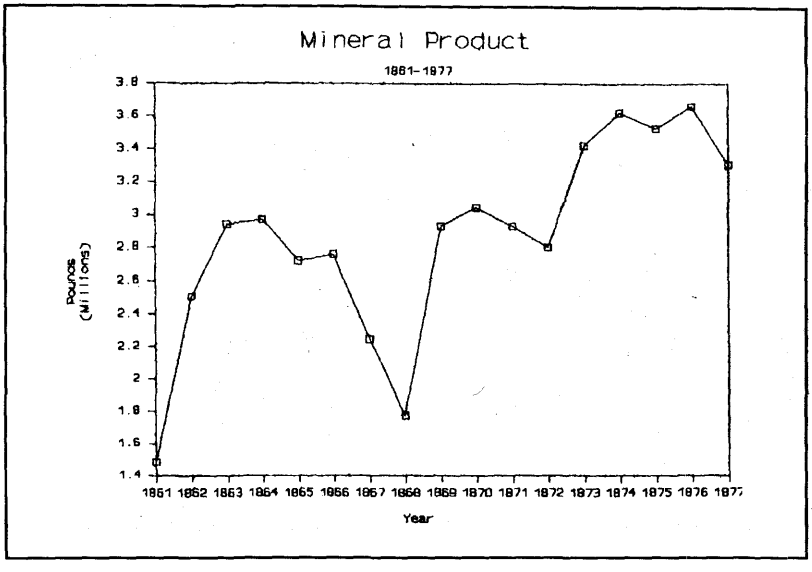
FIGURE 2



[6] U.S. Bureau of Mines. 1990. Nonferrous Metal Prices in the United States through 1988.

Figure 3 shows the mineral produced between 1861 and 1877 and indicates a low for the period in 1868. Both copper prices and the firm's production volume reflect the disruption of

FIGURE 3



the copper market following the Civil War as the war demand disappeared and the government reduced its stockpiles. The Directors' Report for 1865 states:

> In preparing the exhibit of the results of the business of 1864, presented in their last report, your Directors made the unfortunate error of overestimating the value of the copper on hand ... (since the copper was sold when) from the cessation of the war, values of all kinds had materially declined, and the market price for copper had reached it slowest point.

EXPENDITURES

Figure 1 also suggests that the firm responded to the weakening copper market by reducing total expenditures, which can be subdivided into costs at the mine and corporate costs. The former consists of mine labor, supplies, and other costs that were incurred during actual mining operations. Corporate costs include expenditures related to non-mining activities such as smelting, shipping, marketing, general corporate administra-

tion, and acquisition of capital assets. Each of these cost categories is examined in the following paragraphs in order to clarify the actions taken by the Quincy management in response to decreasing revenues during the post war market disruptions.

Total Costs at the Mine

The cost data used in this section is from a schedule entitled "Return of Mining Cost for the Year" (Figure 4) ,which first appeared in the annual report of the Quincy Mining Company in 1863. The schedule provided monthly and annual totals for the various types of mine labor and for mining supplies. These costs were then summarized and carried into the "Return of Working

FIGURE 4

Source: QMC annual report for 1863

Return of Mining Cost For the Year Ending December 31st, 1863

	Jan.	Feb.	Mar.	Apr.	May	June-Dec. Omitted	Total
No. Fms. Stoped	157.99	311.57	364.63	357.13	459.57	.....	4294.8
No. of Feet Drifted	257	167	188	247	248	.....	2502
No. Feet Sunk-Shafts	43	10	78	158	18	.....	651
No. Feet sunk-Winzes	59	90	0	87	71	.....	475
Amt. Pd. for Stoping	2856.96	5760.13	6611.59	6518.86	8817.58	.....	$82,407.88
" " for Drifting	2702.90	1989.50	2245.66	3049.96	3187.99	.....	$30,517.21
Pd. for Sinking Shafts	$596.66	$200.00	$1,659.58	$3,386.00	$280.00	.....	$15,054.07
Pd. for Sinking Winzes	$858.00	$1,215.00	$0.00	$1,228.74	$995.16	.....	$6,777.90
Average price per fathom for Stoping	$18.14	$18.50	$18.15	$18.23	$19.20	.....	$19.20
Average price per foot for Drifting	$10.49	$11.90	$11.89	$12.35	$12.83	.....	$12.17
Average price per ft. for sinking-Shafts	$13.82	$20.00	$21.17	$21.36	$15.00	.....	$23.02
for sinking-Winzes	$14.38	$13.50	$0.00	$14.00	$14.00	.....	$14.23
Extra Work Aside from Contracts	$1,142.52	$1,310.04	$875.10	$1,251.16	$1,006.26	.....	$10,769.27
Mining cast, Powder Fuse, Candles, etc.	$1,450.36	$1,991.99	$2,270.62	$2,732.92	$2,534.90	.....	$25,761.14
Amount	8157.04	10474.67	11391.93	15434.72	14286.99	.....	$145,586.36

Brought down	$145,586.36
Mining Captains and Timbermen	7,058.43
Miners on Company Account	12,292.69
Laboring Hands, Including Landers and fillers	42,460.82
Engineers and Firemen at Hoisting Engines	4,135.28
Carpenter Labor	1,420.02
Blacksmith Labor	3,538.61
Machinist Labor	451.79
Supplies and Material Used	21,962.58
Total	$238,906.58

Expenses at Mine" (Figure 5), which presented the costs incurred at the mine by major categories (Mining Cost, Assorting

FIGURE 5

Source: QMC annual report for 1863

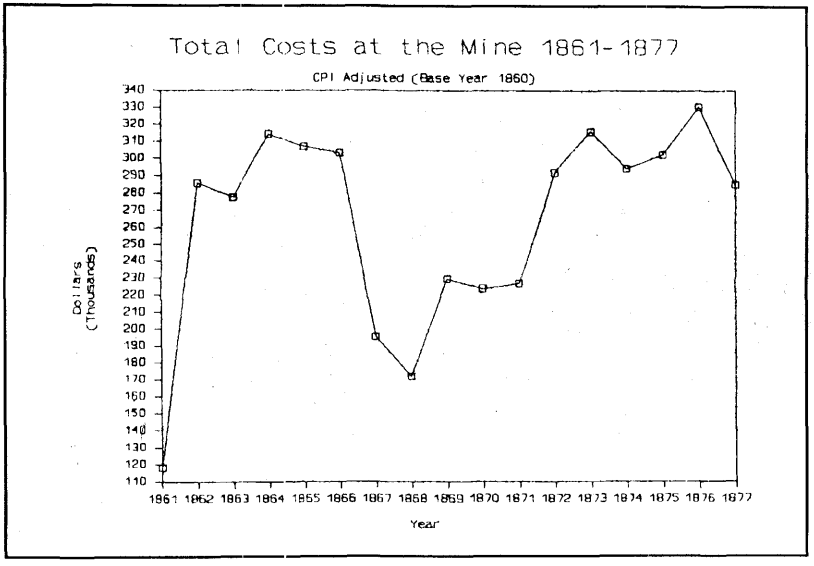
RETURN OF WORKING EXPENSES AT MINE FOR THE YEAR ENDING DECEMBER 31, 1863

Mining Cost		
As per table on preceding page		$238,906.58
Assorting, Breaking, and Calcining Rock		
Breaking 38,070 tons rock.....	$22,187.97	
Assorting 46,408 " "	3,474.78	
Wood used for fuel,.....	102.92	
		25,765.67
Tramming Rock To Mill		
Tramming 46,408 tons rock		
" 1,685 " barrel-work	$ 9,313.14	
Supplies and materials used,.....	2,629.48	
		11,942.62
Stamp Mill		
Stamping and dressing 48,985 tons rock		
" " " 1,685 " barrel-work.....	$40,573.18	
Supplies and materials used,.....	24,015.70	
		64,588.88
Surface and General Expense		
Salaries of officers and general surface expense.....	$35,577.68	
Cost of tribute copper.....	2,943.28	
Amount of taxes paid,.....	3,311.62	
Freight on supplies up,.....	5,407.13	
Expenses of improving farm,.....	342.30	
	$47,582.01	
Cr. by profit on supplies,.....	2,810.51	
		44,771.50
Total running expense,.....		$385,975.25

and Breaking Rock, Tramming, Stamp Mill, and Surface and General Expenses). Each of these categories was derived from natural divisions in the mining process.

Figure 6 shows that total costs at the mine (adjusted to 1860 prices) decreased sharply between 1866 and 1868, with increases in subsequent years. Although some differences in timing and magnitude are apparent (Figure 7), total costs at the mine appear to be associated with the quantity of mineral produced.[7]

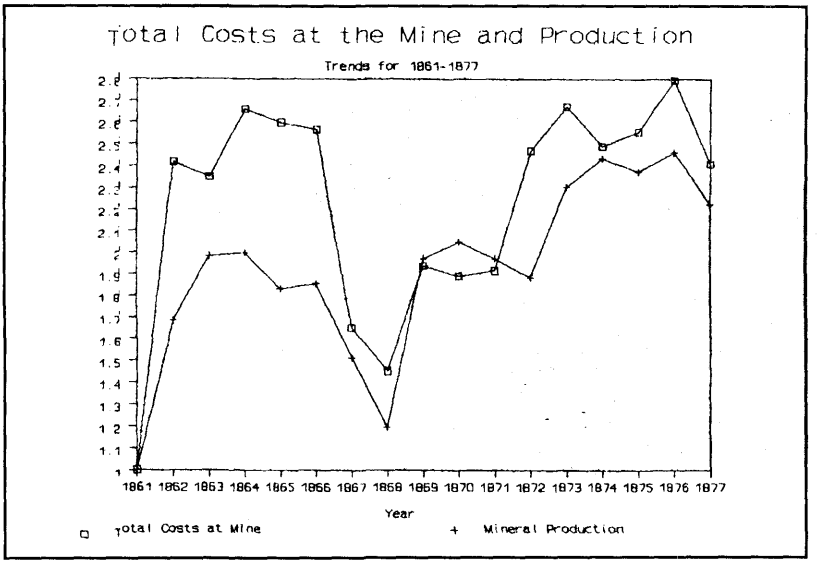
FIGURE 6



[7] A simple regression using mineral produced as the independent variable and total costs at the mine (price adjusted) as the dependent variable yielded the following results:

Constant	38,995.65
X Coefficient	0.078268
Standard error of Coefficient	0.015153
R Squared	0.6401
T Value	5.2

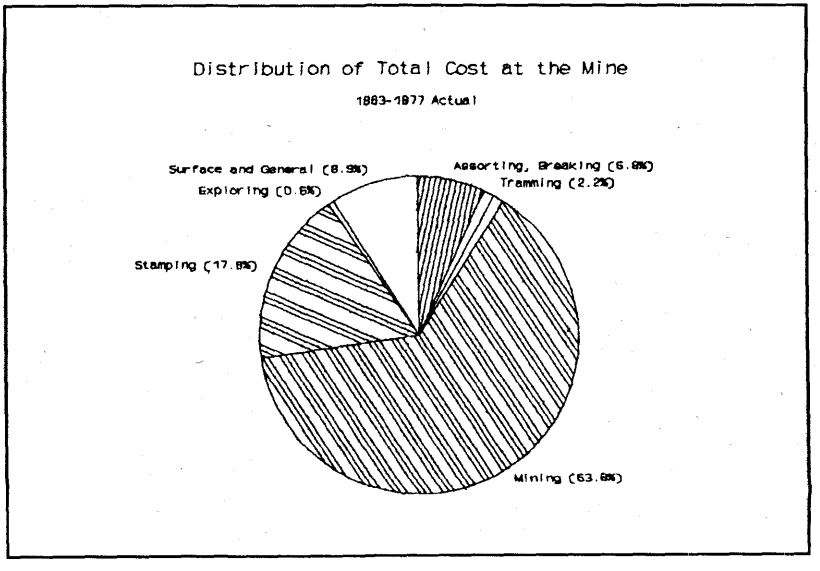
FIGURE 7



Mining Cost

As shown in Figure 8, actual mining costs were the largest component (63.8%) of total costs at the mine between 1863 and 1877. Mining costs, following the pattern of total costs at the

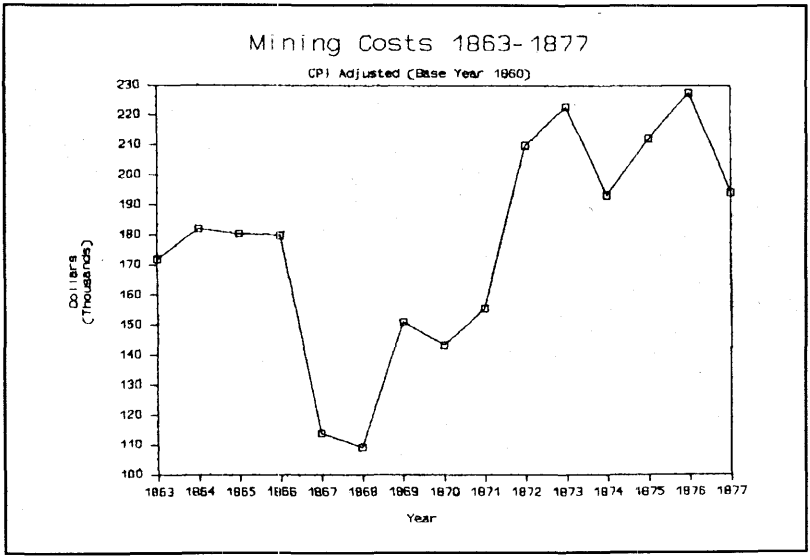
FIGURE 8



mine, dropped sharply between 1866 and 1868, followed by increases in later years (Figure 9). The trends for mining cost and mineral production (Figure 10) appear to be correlated.[8]

The cost classifications provided in the "Return of Mining Cost for the Year" schedule for each year between 1863 and 1877 show that an average of about sixty percent of mining costs were directly related to labor within the mine, about thirty percent was related to supervision and the labor costs of non-mining support activities, with the remaining ten percent representing supplies and materials.

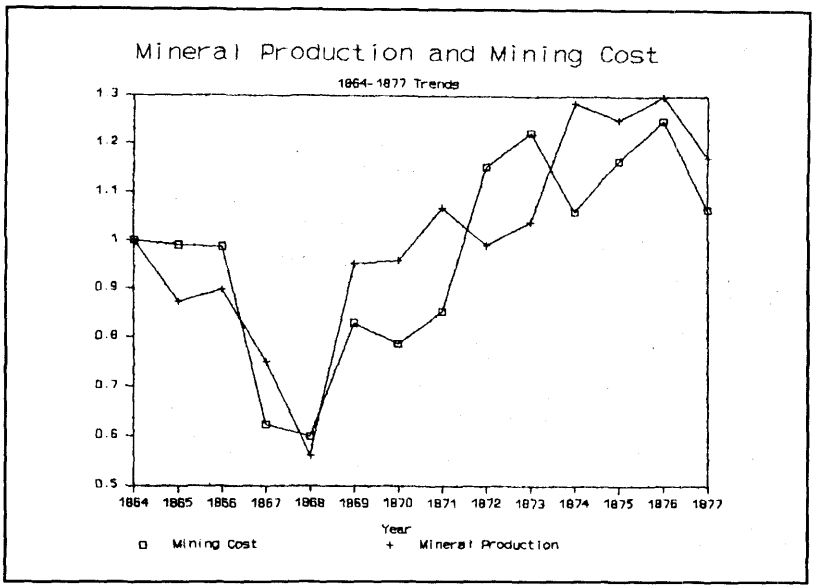
FIGURE 9



[8] A simple regression using mineral produced as the independent variable and total mining cost (price adjusted) as the dependent variable yielded the following results:

Constant	-7321.78
X Coefficient	22,225.16
Standard error of Coefficient	.0099283
R Squared	.748336
T Value	6.678

FIGURE 10



Supplies and Materials. Figure 11, which shows both the actual and price adjusted costs for mining supplies, indicates that a reduction in the cost of mining supplies occurred between 1865 and 1867.[9] At least part of this reduction can be attributed to the level of mineral production, since as shown in Figure 12, both the cost of supplies and the level of production decreased during that period. However, there is insufficient information available to determine if fewer supplies were used, supplies were not replenished (and expensed) or cheaper supplies were used. In general, the cost of mining supplies increased when production increased after 1868.[10]

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[9] The expense category of "Mining Supplies" includes explosives, fuses, tools, drill bits, lubricants and other materials used by the miners.

[10] Figure 12 shows a sharp downward trend in 1871 even though production was increasing. This apparent anomaly may be due to accounting procedures rather than actual usage. The annual report of the Quincy Mining Company for 1871 reports the creation of "... the special reserve fund of fifty thousand dollars, set apart as heretofore reported, for the endowment of an insurance and repairs account, and fully secured by mineral, mining supplies and materials." In other words, mining supplies were purchased then set aside as a reserve fund, rather than being charged to the supplies account as an expenditure.

FIGURE 11

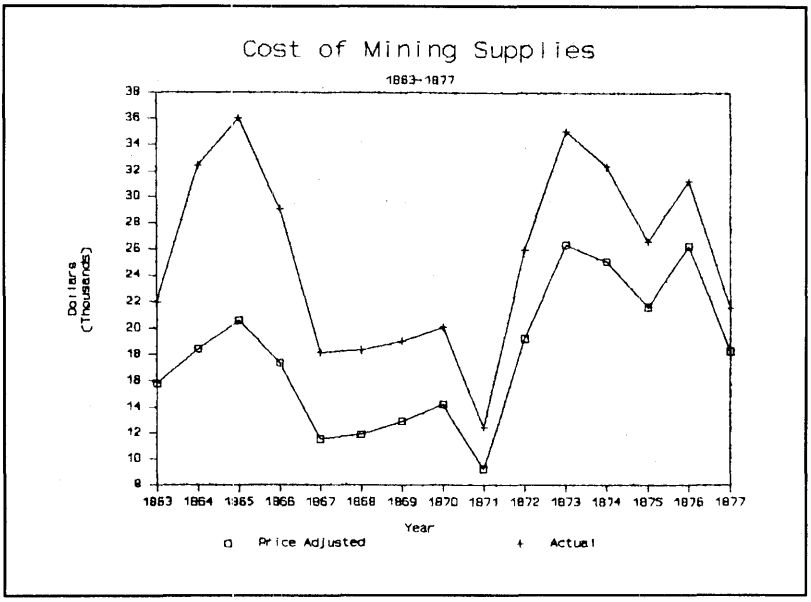
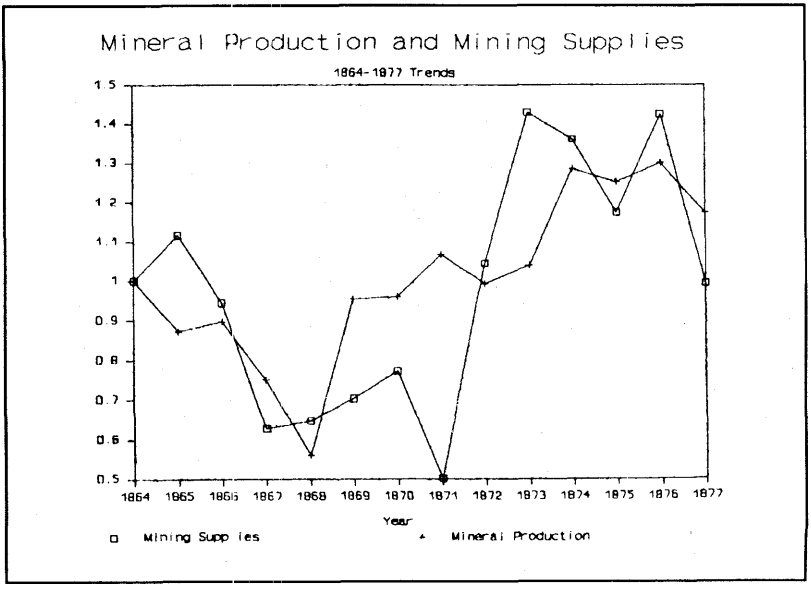


FIGURE 12



Mine Labor. Since mining processes in the mid-nineteenth century were labor intensive, the majority of the mining cost reductions observed between 1866 and 1868 are traceable to either labor wages or the number of employees. Figure 13, which shows both the average number of miners employed and the average non-miner labor force, indicates that the company reduced the number of miners employed between 1866 and 1868, but even larger reductions were made in non-miner work force. The number of miners employed increased to the pre-reduction levels between 1869 and 1877 as production increased, but the non-mining reductions were permanent.

FIGURE 13

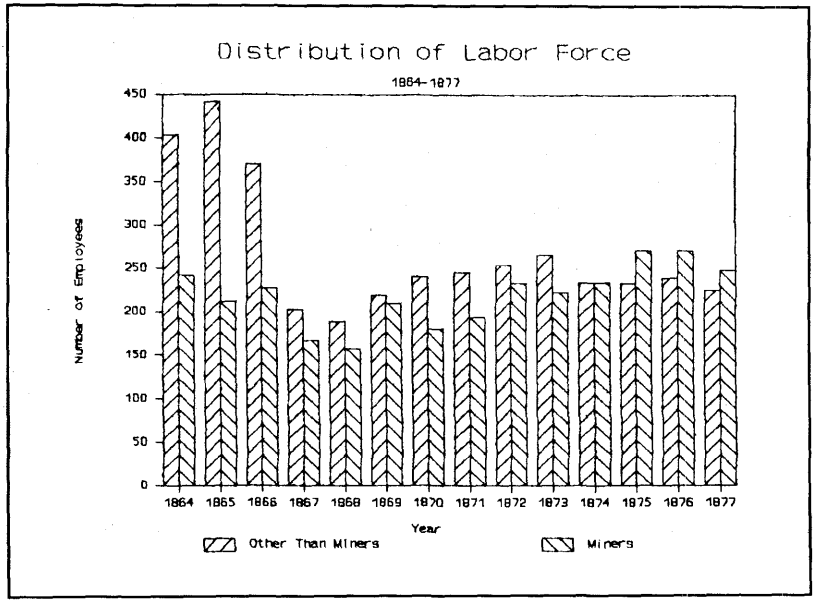
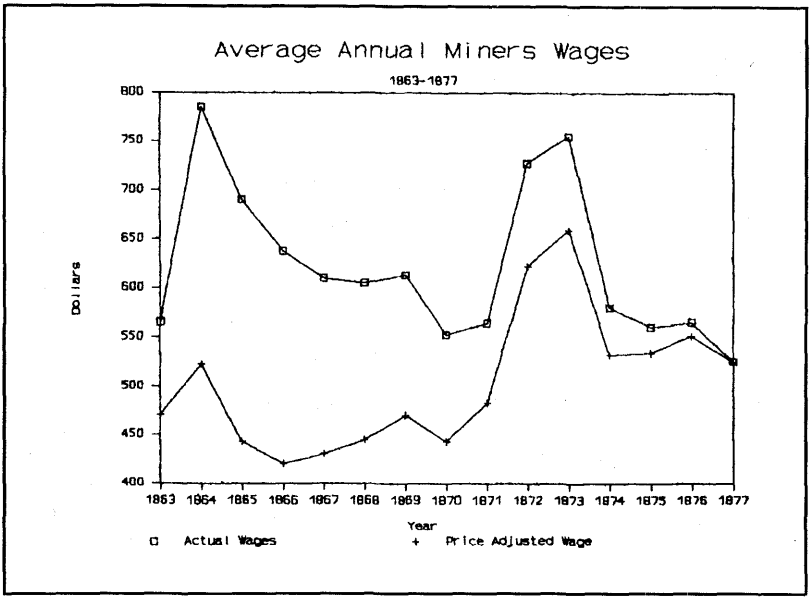


Figure 14 shows that both actual and real wages paid to miners decreased sharply between 1864 and 1866. Although actual wages continued to fall between 1866 and 1868, real wages actually increased slightly. However, real wages did not reach the levels observed in 1864 until 1872 when a temporary labor shortage combined with a strike by the miners temporarily forced wage levels upward.[11]

[11] The Directors' Report for 1872 states "Owing to the great scarcity of labor on the Lake, we were compelled last April to concede a considerable advance in

FIGURE 14



As shown in Figure 15, which compares the wages of the Quincy miners with the average non-farm wage between 1863 and 1877, the Quincy miners were well paid relative to other occupations.[12] This has two ramifications. First, although there may be similarities between wage levels at the Quincy Mine and general wage levels, the miners wages also reflect the local labor market. For example, as shown in Figure 16, the post war decline in miners wages exceeded the trend for consumer prices. Similarly, the local labor shortage in 1872 and 1873 resulted in wage increases even though price levels were falling. Second, since miners had specialized skills and performed the most dangerous of the mining activities, their pay level probably represents the maximum expectation for other activities within the mine. In other words, if miners wages fell during a given year, it is likely that all other laborers wages were also reduced.

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wages in order to keep all departments of the mine in full operation; and a very high price of labor was obtained to the present time. It is hoped that the present high rates will attract an increased supply of mining labor to the Lake. . . . "

[12] U.S. Department of Commerce. 1975. *Historical Statistics of the United States: Colonial Times to 1970.* Average Annual and Daily Earnings of Nonfarm Employees: 1860 to 1900. Series D 735-738, p. 165.

FIGURE 15

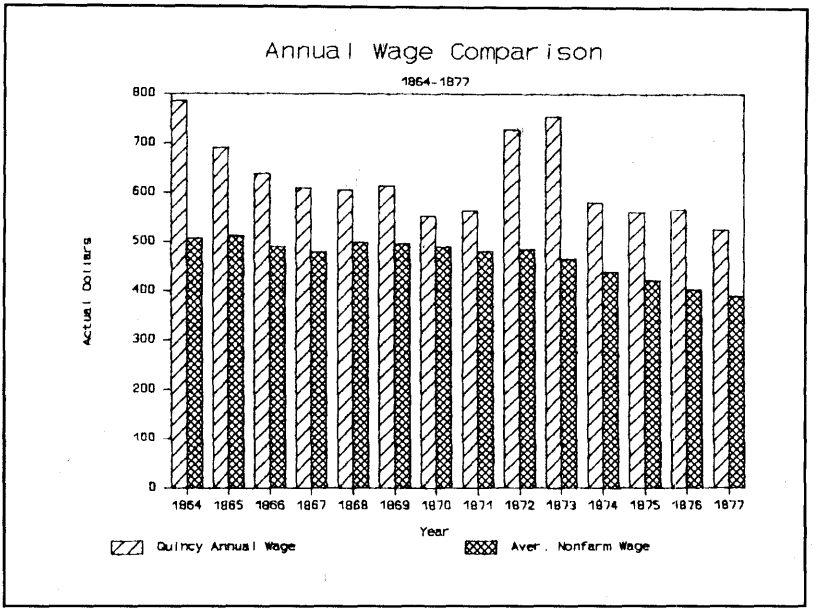
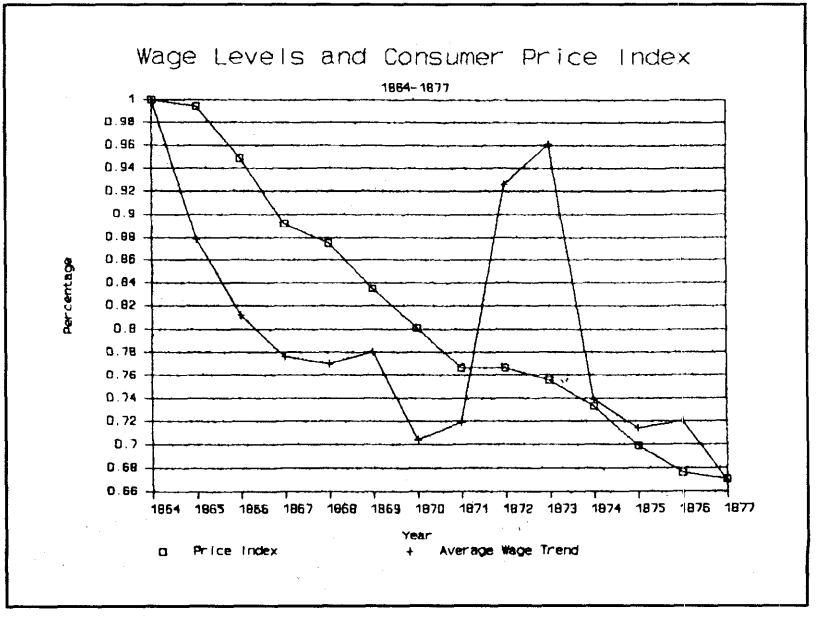


FIGURE 16



Supervision and Support Activities. The two largest categories of non-miner labor, Mining Captains and Timbermen (Figure 17), and Laboring Hands (Figure 18) each show a large

FIGURE 17

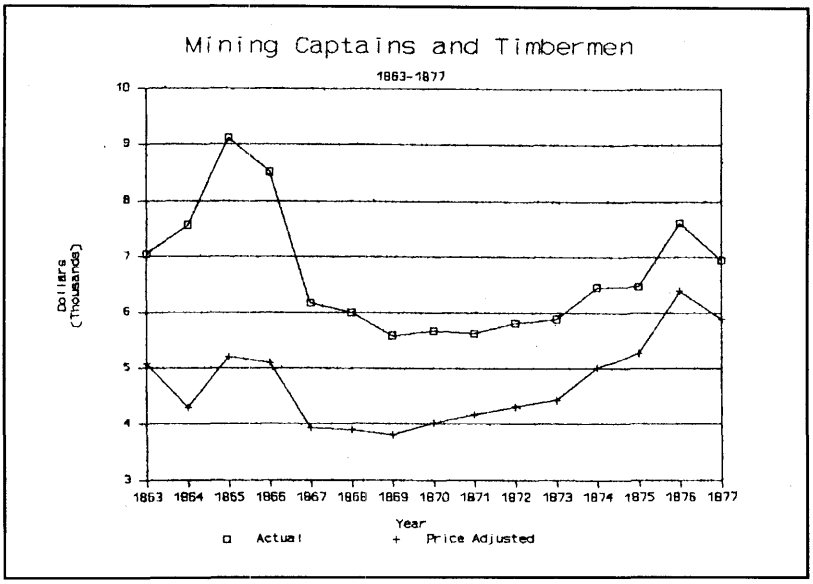
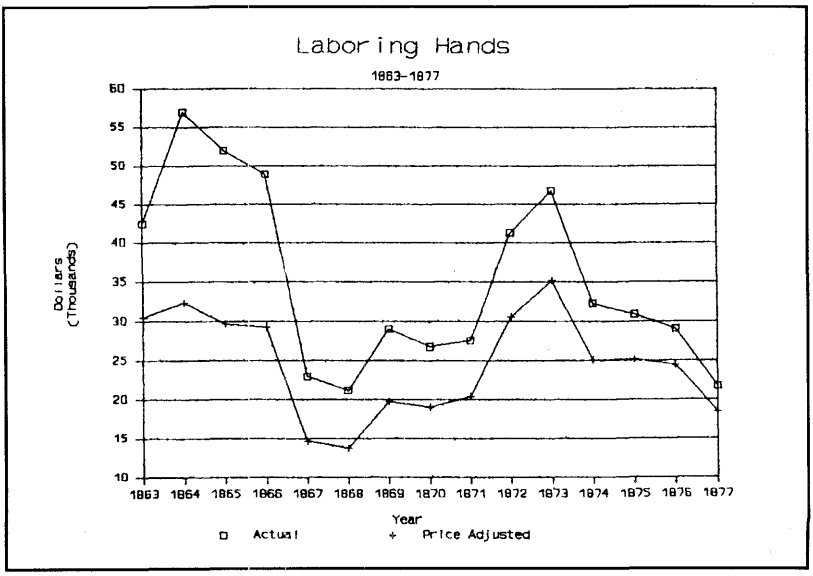


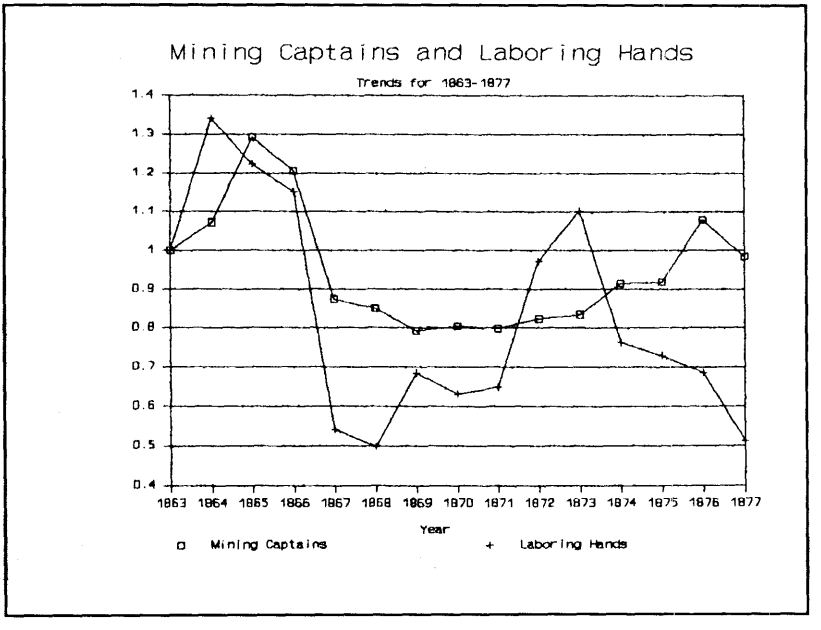
FIGURE 18



decrease in 1867 followed by a smaller decrease in 1868. However, insufficient information is available to determine either specific wage levels or the number of laborers within these occupations. But, given the reductions in the non-miner labor force that occurred in 1867 and 1868 (Figure 13) and the wage level of the miners, it is likely that such measures would also be directed at support labor.

Although reductions are evident in both accounts between 1866 and 1868, a comparison of the trends for Mining Captains and Timbermen, and Laboring Hands (Figure 19) indicates that

FIGURE 19

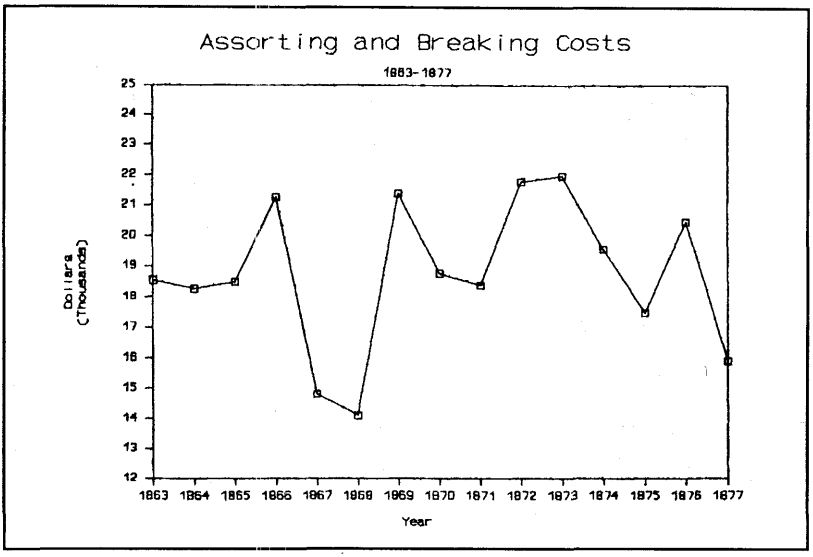


the reductions were not uniformly distributed. The account for Mining Captains and Timbermen, after a large decline in 1867, shows moderate growth until 1875. In contrast the account for Laboring Hands suffered a more severe reduction in 1867 and experienced a larger increase during 1872 and 1873.

Assorting and Breaking Rock

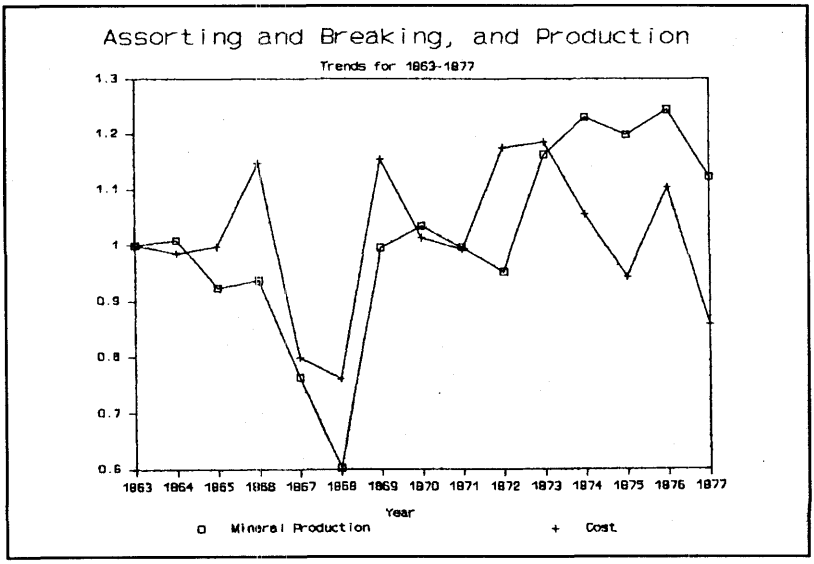
The cost of assorting and breaking activities between 1863 and 1873 (Figure 20), reflects both the general wage level and

FIGURE 20



the quantity of mineral produced. The process of sorting and breaking rock to be sent to the stamp mill was a labor intensive process. As shown in Figure 14, the wages for miners increased in 1869, 1872 and 1873. Assorting and Breaking costs also increased during these years. Figure 21, which shows the trends

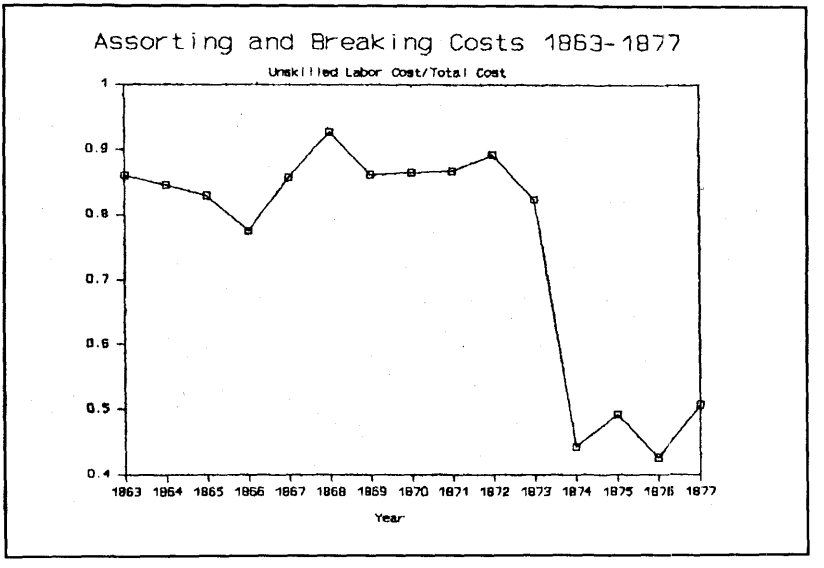
FIGURE 21



for Assorting and Breaking costs and mineral produced, indicates that both decreased between 1866 and 1868. Since the non-miner labor force was reduced during this period (Figure 13), it is likely that similar reduction occurred in the number of laborers engaged in assorting and breaking activities.

Assorting and Breaking costs can be divided into three general categories, unskilled labor, skilled labor, and material and supplies. As shown in Figure 22, between 1863 and 1873 over

FIGURE 22



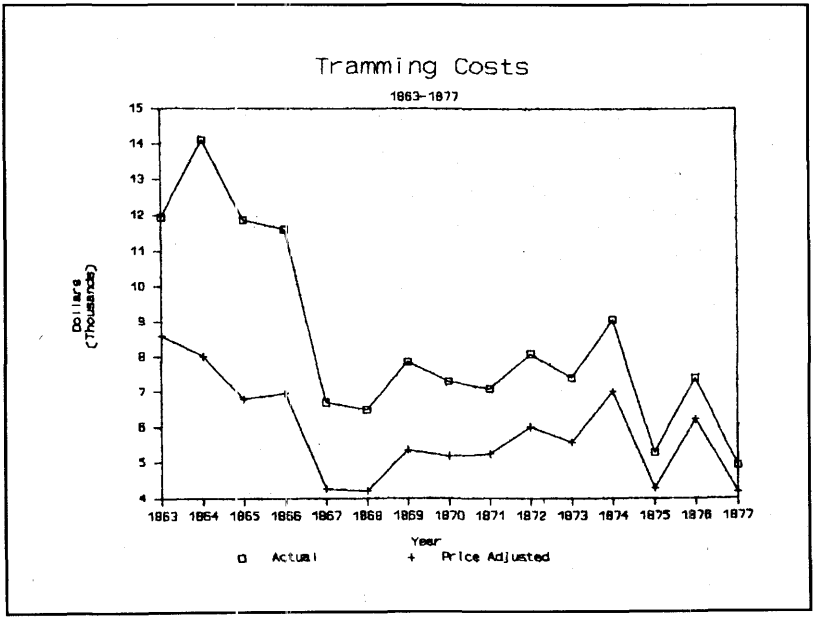
80% of Assorting and Breaking cost could be traced to unskilled labor. But in 1874 unskilled labor became less significant when increases in both the cost of skilled labor (blacksmiths, engineers and brakemen) and the cost of material and supplies occurred. This transformation can be related to a technological change. The annual report of the Quincy Mining Company for 1873 recorded expenditures of $14,915.45 for a new rockhouse and mechanical devices. The Agent's report for that year states the new facility enabled the company to "handle with dispatch, all the rock we can hoist, and at a much less cost than by the old method of calcining, and breaking by hand". This improvement is evident in Figure 21 after 1873 when mineral production increased even though Assorting and Breaking cost decreased (with the exception of 1876 when general wage levels increased).

In summary, Assorting and Breaking costs prior to 1874 reflect both the general wage level and the amount of mineral produced. In the short run costs were reduced by reducing the size of the labor force and reducing wages (subject to the constraints of the local labor market). Long term cost reductions were achieved by altering the nature of the production process.

Tramming

Tramming costs were sharply reduced between 1866 and 1867 (Figure 23) and, although year to year fluctuations occurred after 1868, the reductions were permanent.[13] As shown in

FIGURE 23



[13] Tramming can refer to both underground and surface activities. The analysis used in this paper is based upon the information provided in Figure 5, which appears to include only surface tramming.

Figure 24, the reduction in Tramming cost in 1866 is associated with a decrease in mineral production. However, when production increased in 1869 to its former level, tramming cost remained relatively low.

FIGURE 24

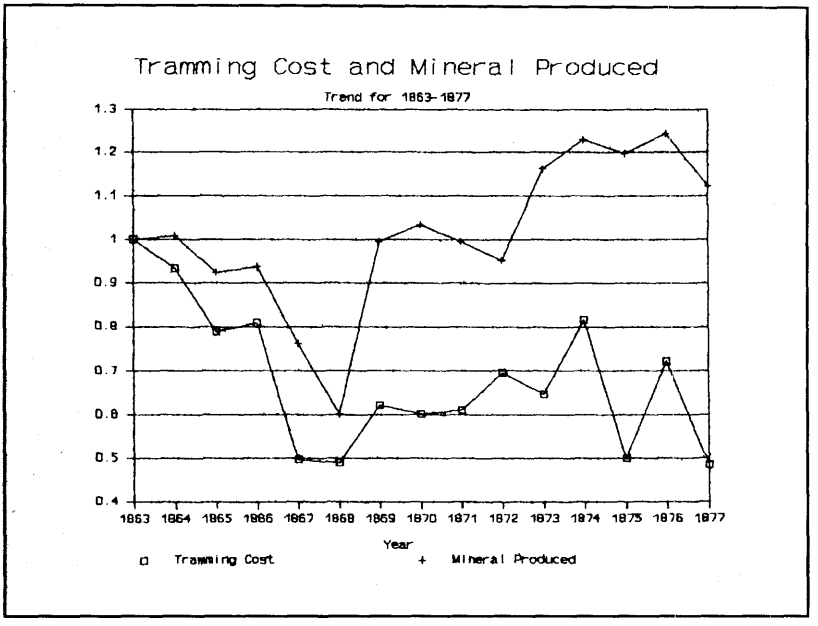
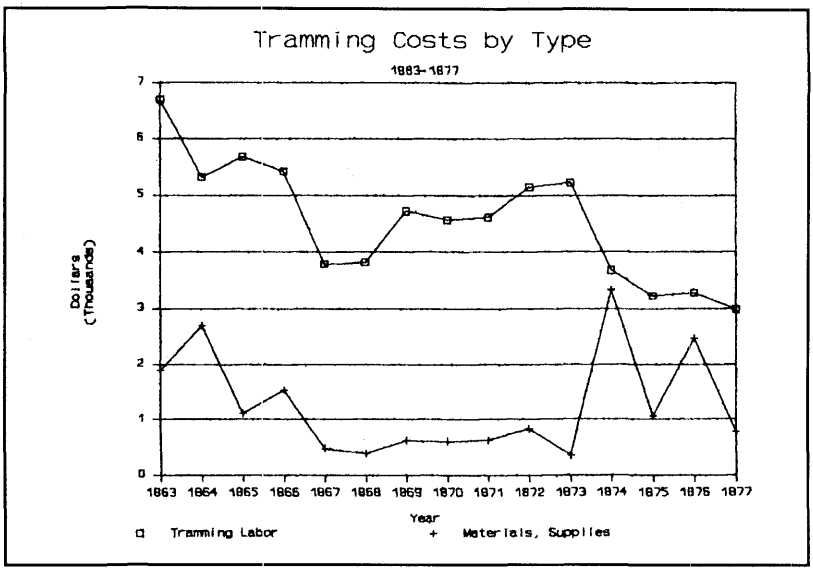


Figure 25, which shows the cost of tramming material and supplies, and tramming labor, indicates that a reduction occurred in both categories between 1866 and 1868. Material and supply costs were kept relatively low until 1874 when extensive repairs occurred.[14] In the hierarchy of the mine labor force, tramming was the most physically demanding labor, required the least skills and trammers received the lowest pay. Given the cost reductions in the labor associated with mining, and assorting and breaking, similar reductions in tramming labor were likely. However, tramming labor also reflects the same increases

[14] The Quincy Mining Company's annual report for 1874 states "We found it necessary to substitute heavier T rail on the road from the mine to the rock house; also to cover the most exposed portions of this road with snow sheds . . . The tram-road incline has been planked over, the rock boxes and trestle work at stamp mill thoroughly overhauled and rebuilt, and but slight repairs will be needed for years to come."

FIGURE 25



in 1869, 1872 and 1873 (followed by a sharp decrease in 1874) that were noted previously in miners' wages (Figure 14). Although the Quincy management was able to permanently reduce the total cost of tramming labor, the wage component was subject to the constraints imposed by the local labor market.

Stamp Mill

The first annual report issued by the Quincy Mining Company, for the year of 1861, included a report labeled "Operation of 64 Heads, Wayne Stamps" (Figure 26) that provided detailed cost information about the stamp mill. Although the information provided changed from year to year, the report was issued annually through 1877. When it was first issued in 1863, the "Return of Mining Cost of the Year" schedule contained only the summarized cost of stamp mill labor, and mill supplies and materials, but the detailed information was still available in the stamp mill report.

Figure 27 shows that the cost of the stamp mill (when adjusted to 1860 price levels) is associated with the level of mineral production. Sufficient information is provided within the firm's annual reports to subdivide total stamp mill costs into repair

FIGURE 26

Source: QMC annual report for 1861

OPERATION OF 64 HEADS, WAYNE STAMPS

FOR FIVE MONTHS, ENDING JULY 31, 1861

	March	April	May	June	July	Total
RUNNING EXPENSES						
Number of cords wood used for fuel	414.75	373.25	344	330	353	1815
Cost of wood consumed	$1,059.45	951.19	882.75	847.50	911.62	$4,652.51
Cords of wood used for heating	20	5	0	0	0	25
Cost of wood used for heating	$47.50	11.87	0	0	0	$59.37
Value of tallow and oil used for machinery	$75.00	68.60	62.27	32.1	35.7	$273.67
Value of oil used for lighting building	$62.62	60.40	54.00	37.50	44.20	$258.72
Cost of engineer, firemen, wooodpassers and wood splitters	$268.03	268.59	262.00	241.50	252.83	$1,292.95
Cost of Superintendent and watchman	$107.30	108.38	109.45	102.84	108.38	$536.35
Cost of Stamp tenders	$260.70	253.20	261.91	251.16	250.91	$1,277.88
Cost of washers	$1,573.94	1515.87	1415.20	1362.32	1360.98	$7,228.31
Cost of cooper	$31.37	32.00	33.23	30.76	32.00	$159.36
COST OF REPAIRS						
Labor for repairs:						
Cost of machinist and blacksmith's labor on machinery	$33.00	145.82	100.86	151.85	92.51	$524.04
Cost of carpenters and laborers on machinery	$215.37	170.80	165.64	119.10	98.25	$769.16
Cost of carpenters and laborers on building	$147.16	113.54	111.87	95.00	12.00	$479.57
Materials:						
Cost of materials used repairing machinery and building	$110.47	214.86	521.28	195.06	181.28	$1,222.95
Total cost	$3,991.91	3915.12	3980.46	3466.69	3380.66	$18,734.84
Cost per ton of rock stamped	$1.0275	1.0325	1.08	0.98	0.8475	
RESULTS						
No. of days run, 24 hrs. each day	26	26	27	25	26	
Average number of heads run per day	61	60.6	62	63.3	63.25	
Tons of rock stamped in a month	3,898	3,780	3,680	3,530	4,000	18,888
Tons of rock stamped per cord of wood	9.4	10.01	10.7	10.7	11.33	
No. of hours stopped for repairs	6.25	2	1	12.5	0	
Copper product, pounds	183,704	207,605	195,807	185,285	182,995	955,396
Percentage of copper per ton of rock	2.34	2.74	2.66	2.62	2.38	

costs and operating costs. Figure 28 shows that both repair and operating costs dropped sharply between 1867 and 1868, followed by increases in subsequent years as production increased. Operating costs appear to have stabilized after 1873, whereas repair costs continued to increase along with production. Both repair and operating costs can be further subdivided into labor

FIGURE 27

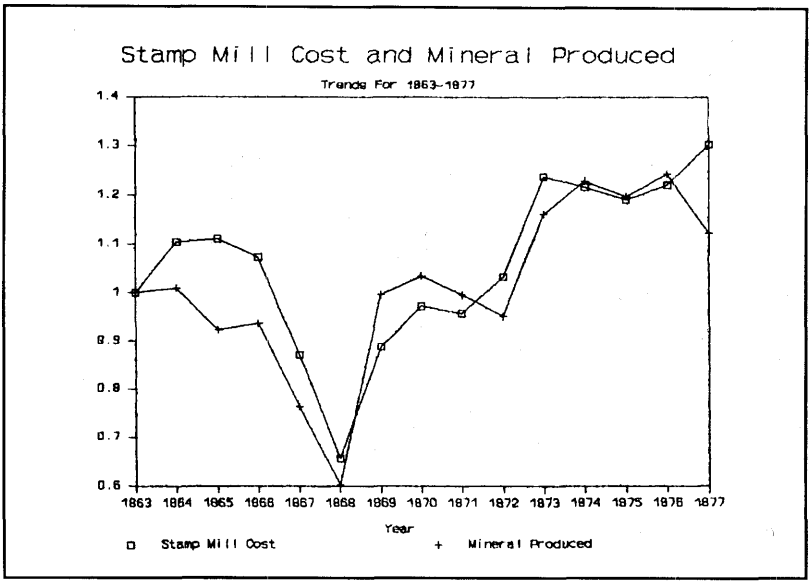
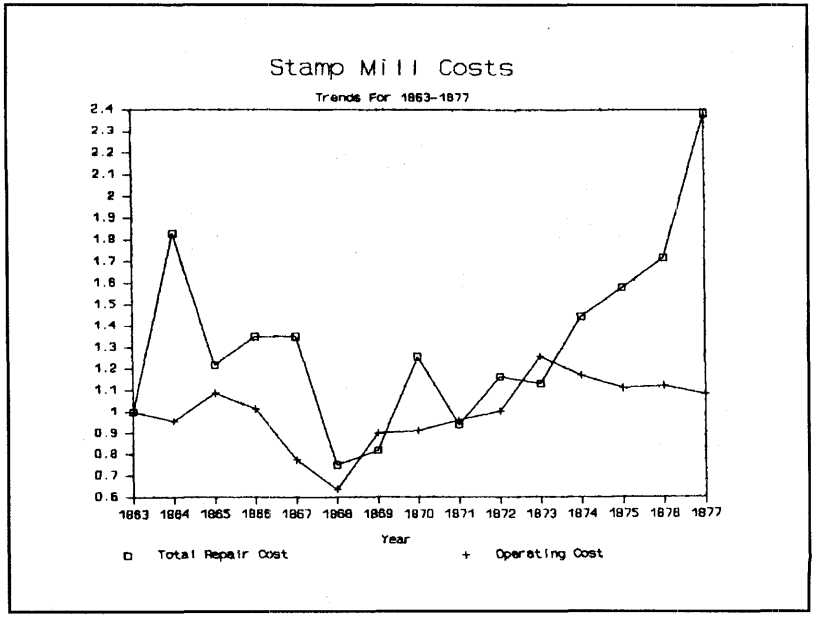
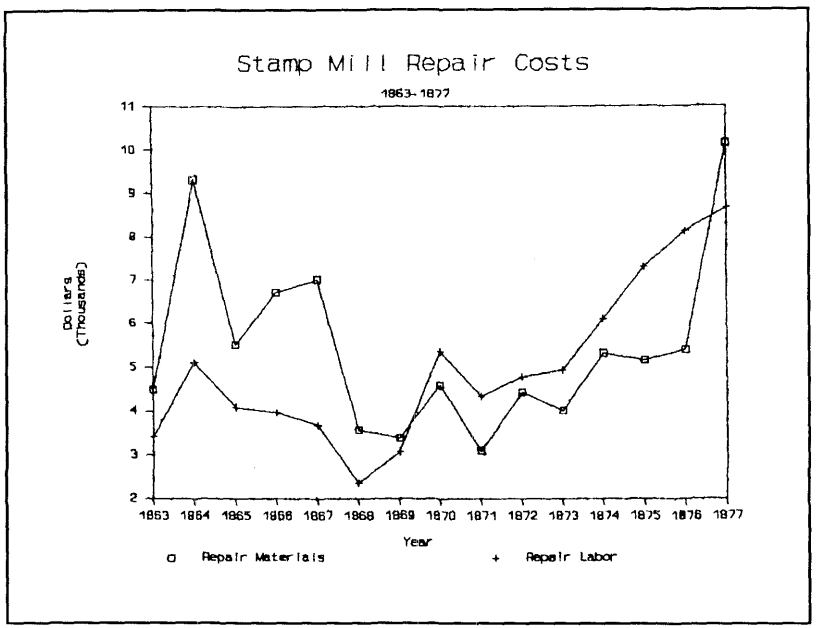


FIGURE 28



and materials. Figure 29 shows that both repair labor and repair material decreased between 1867 and 1868 then increased in subsequent years. Repair labor, however, does not appear to

FIGURE 29



reflect the large increases observed in other labor categories in 1872 and 1873, followed by decreases in 1874. Instead repair labor increased each year between 1871 and 1877. This suggests that repair labor was less susceptible to the market forces that effected other labor categories. In contrast, the cost of operating labor within the mill reflects the previously noted increases in 1869 and 1873, followed by a decrease in 1874. This suggests that operating labor and repair labor may have been subject to different market conditions, probably due to the skills required for each occupation. Presumably, the repair of the stamp mill equipment would require more training and experience than the operation of the equipment.

Further evidence for the differentiation of the labor force is evident with the broad category of operating labor. For example, Figure 30 shows that Superintendents and Watchmen costs increased each year between 1866 and 1876. Conspicuously absent are the previously noted reductions between 1866 and 1868,

FIGURE 30

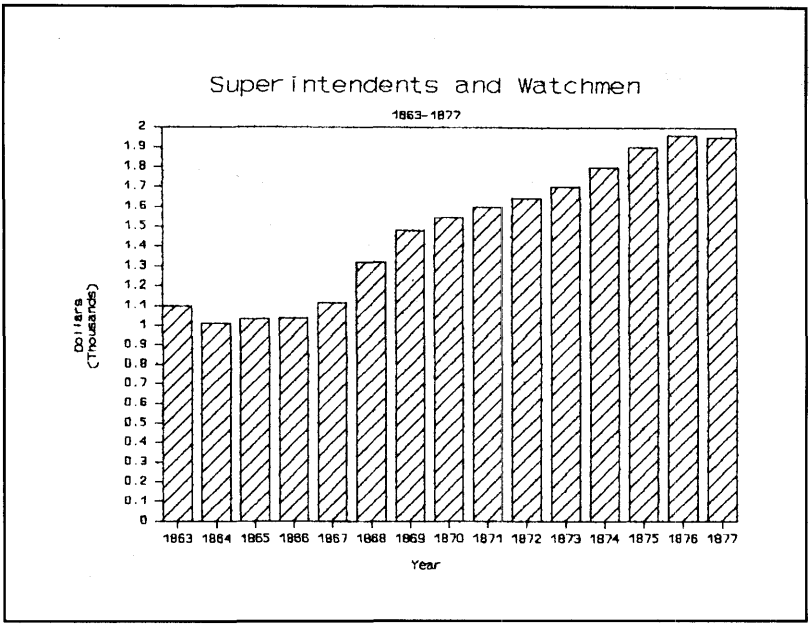
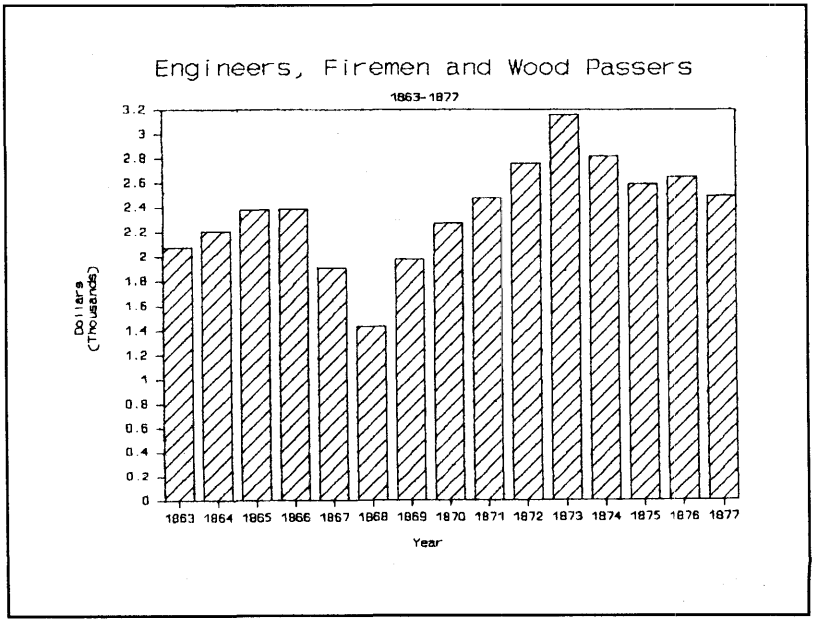
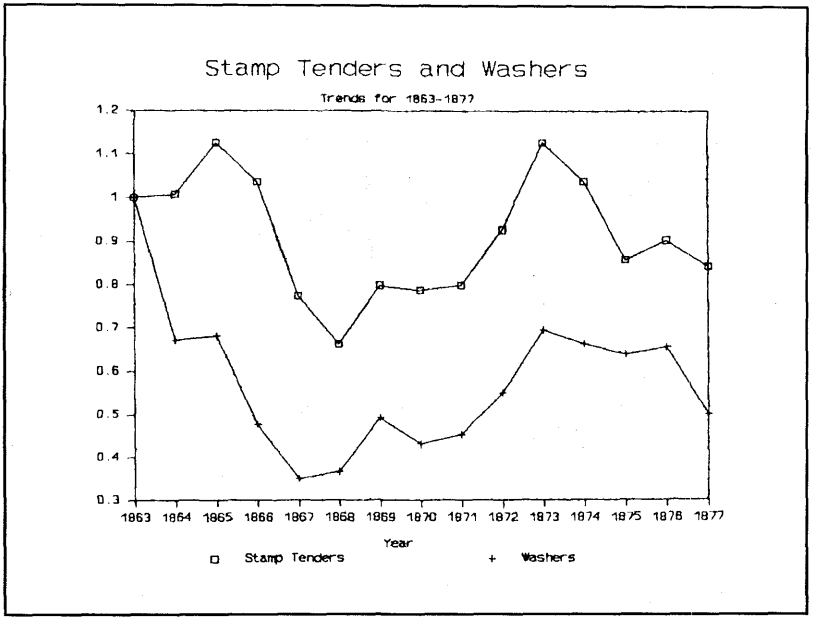


FIGURE 31



increases in 1869, 1872 and 1873, followed by reduction in 1874. In contrast, the cost of Engineers, Firemen and Wood Passers reflects each of those characteristics (Figure 31). A comparison of two other relatively unskilled operating labor categories, Stamp Tenders and Washers (Figure 32) shows that both reflect the general pattern of wages in the local labor market.

FIGURE 32



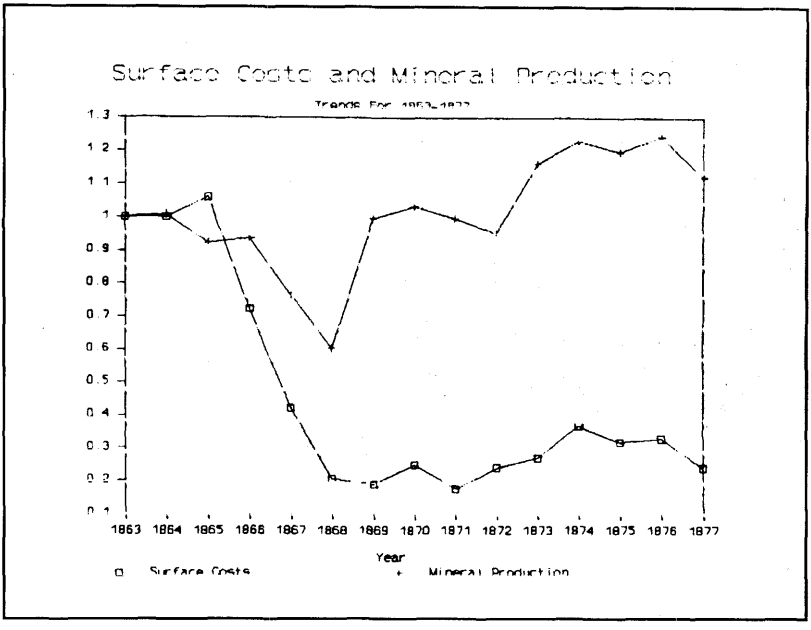
Surface Labor and General Surface Expenses

Between 1863 and 1877 seventeen different types of expenditures were included in this classification.[15] But most of the expenditures were related to two items: Surface Labor and General Surface Expenses (75%) and Taxes (16%).[16] Figure 33 shows

[15] The following expenditures were recorded as Surface Labor and General Surface Expenses: surface labor, general surface costs, taxes, cost of tribute copper, freight on supplies, advances to laborers, improvements to farm, legal services, tolls on mineral, Portage entry tolls, roads, Houghton County draft exemption fund, incidental expenses, warehouse and dock, boarding house, contribution to rebuilding church, indebtedness for hospital fund, and advances made on Stevens slime washers.

[16] In 1863 and 1864 the description "salaries of officers and general surface expense" was used. In 1865 the description was changed to "surface labor and

FIGURE 33



that total costs within this classification decreased between 1866 and 1868. Although these reductions initially coincide with a decrease in mineral production that occurred in 1868, subsequent increases in mineral production did not result in proportionate increases in expenditures. There is insufficient evidence available to determine if the cost reductions were due to labor, process changes, cost reclassification or other factors, but it is apparent that rapid and permanent cost reductions occurred.

CORPORATE COSTS

The annual corporate administrative expenditures are taken from a schedule in the firm's annual reports entitled "Balance Sheet From the Books of the Quincy Mining Company."[17] Expenditures for plant and equipment are taken from a report called "Additions to Permanent Investment". The relative signifi-

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general surface expenses." This suggests that the expenditures included in this category may vary between 1864 and 1865.

[17] Between 1863 and 1877 expenditures were recorded for: Boston office, copper charges, miscellaneous expenses, interest, insurance, labor emigration, smelting, taxes and transportation.

cance of the various types of expenditures classified as corporate costs is shown in Figure 34. Two of the largest expenditures, Smelting (Figure 35) and Transportation (Figure 36), were asso-

FIGURE 34

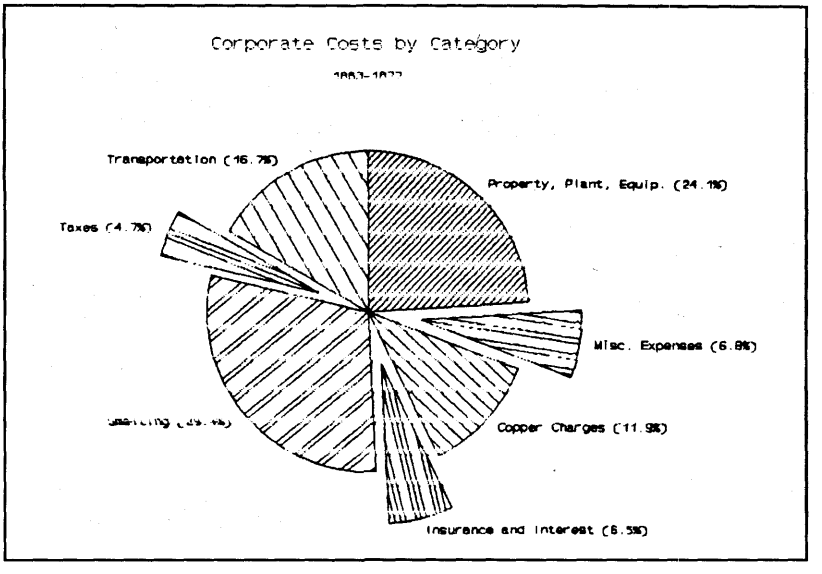
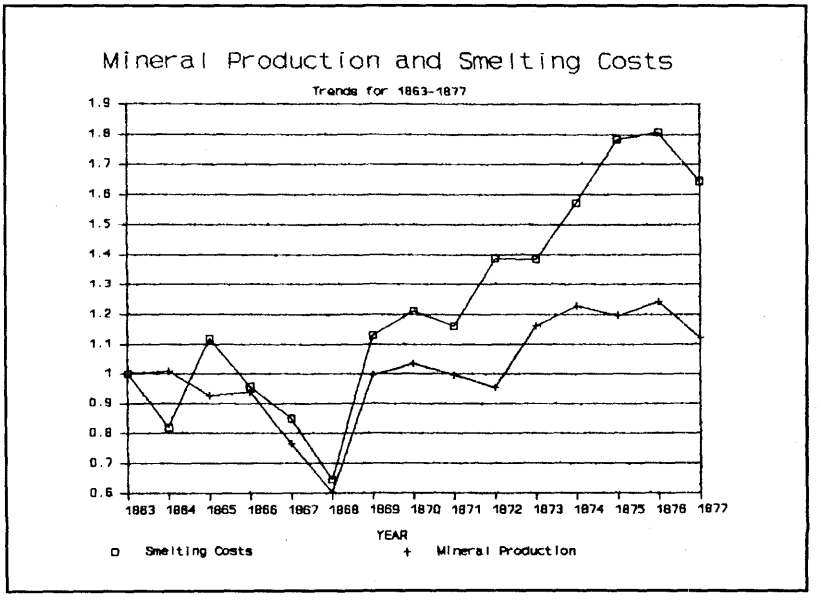


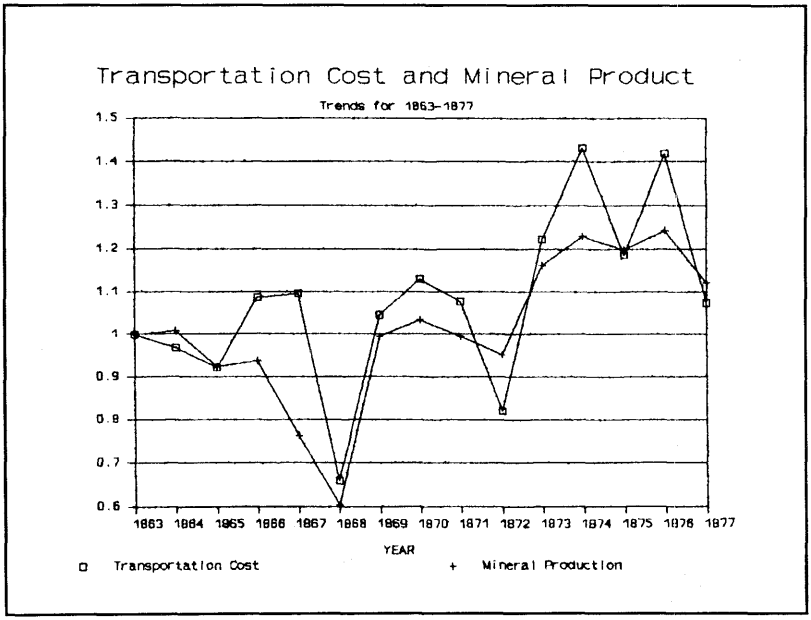
FIGURE 35



ciated with the level of production.[18] Since both of these activities were external to the firm, their annual cost was only marginally controllable by the Quincy management. Figure 37, which shows the expenditures for property, plant and equipment (a controllable cost) depicts increases in 1864 and 1872 with relatively small expenditures in the other years.

The 1864 increase reflects a general expansion at the mine. The 1872 expenditures were primarily for partial construction costs of a new rock house and breakers (discussed in conjunction with Assorting and Breaking cost), and the installation of air compressors and power drills. Since prior to this time drill-

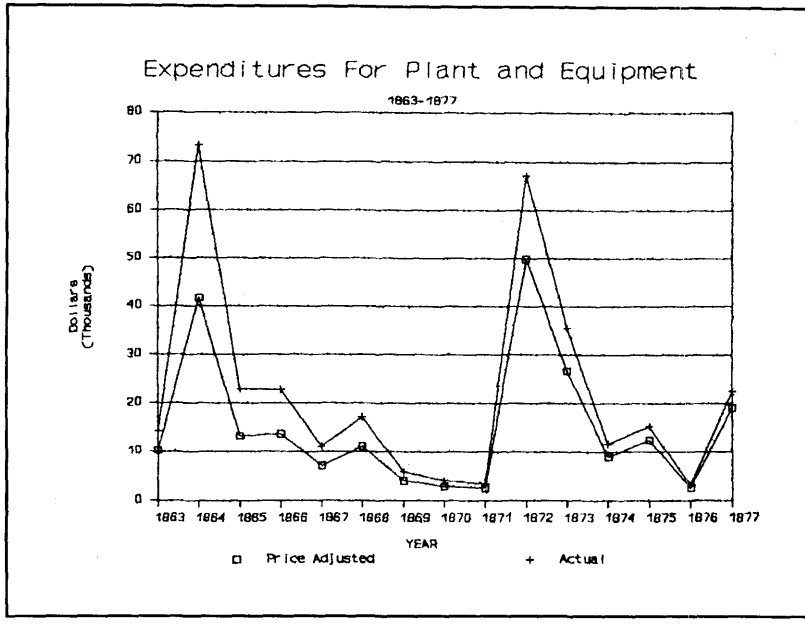
FIGURE 36



[18] Two simple regressions, using mineral produced as the independent variable and smelting cost and transportation cost (price adjusted) as the dependent variable, yielded the following results:

	Smelting	Transportation
Constant	-8801.05	1167.46
X Coefficient	.0094	0.0032
Standard error of Coefficient	0.0016	0.0006
R Squared	0.74	0.67
T Value	6.02	5.10

FIGURE 37



ing was performed by teams of miners using hand tools, the use of power drills was a significant change in the technology of the mining process. Although the firm's motivations are problematic, the introduction of power drills probably represents an unsuccessful attempt to reduce the labor component of production costs.[19] The remaining corporate level expenditures show indications of irregular cost reductions.

In summation, the external financial reporting of the Quincy Mining Company between 1861 and 1877, along with

[19] The Quincy Mining Company's annual report for 1872 states "In common with the other mines in this district, early in the spring, our men 'struck' for much higher wages than we had been paying them; and, during the month of May, all underground operations were suspended nearly two weeks. . . . subsequent operations were greatly embarrassed by the scarcity of miners and laborers, and the extreme high prices necessary to be paid them; all of which has combined to increase the cost of production." The same annual report also states "The power drills were started in October last, . . . The results did not show any material saving over the cost of drifting by hand; and, upon becoming poor, their use was discontinued for the time. The drills worked well when in position, but were found to be too large and cumbersome to handle readily; hence too much time was consumed in getting them back to place after blasting. . . ."

the analysis of the information contained in those reports, indicates the Quincy management was aware of the firm's cost structure and cost behavior patterns. More importantly, the successful cost reduction measures implemented in the post war period suggest they were able to use this knowledge to adjust the activities and costs of the firm in response to market conditions. It is apparent that most non-labor costs at the mine were variable relative to production. In the absence of production decreases or major technological changes, total costs in these categories could be reduced only temporarily. In contrast, the examination of the various cost categories at the mine indicated that labor costs were sharply and permanently reduced. In fact, once the nonessential surface and underground expenses had been eliminated, labor costs were the only other significant expense that could be reduced without impairing production capabilities. Therefore, it seems reasonable to conclude the firm's management had access to sufficient financial information to guide their actions. The following section defines the accounting practices that contributed to the management process.

COST CONTROL

The Quincy accounting system provided cost control information as early as 1860, but the logic of the control processes can be traced to ledger accounts dating from 1847. The basic procedure was to isolate areas of concern, such as a construction project or operating responsibility, in separate general ledger accounts. The first evidence of this process involved establishing accounts for each of the major functional areas at the mine such as Mining, Tram Road, and Stamp Mill.

The number of specific cost accumulation accounts grew as the firm expanded operations prior to the end of the Civil War. For example, the ledger for 1861, which contains 800 pages, has only seven accounts that can be construed as specific cost accumulation accounts.[20] By 1862 there were over twenty such accounts in the ledger, including accounts for a new barn, a house for the president of the firm, a captain's office and a hospital. The number of specific accounts used for functional areas remained relatively stable, but the number of accounts used to

[20] In 1861 the accounts were closed monthly, but in 1862 a switch was made to year end closings, which kept the costs isolated for a longer period and made them easier to monitor throughout the year.

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accumulate capital expenditures by project varied from year to year along with the number of "projects" in process.

This ledger procedure, when combined with the year end closing implemented in 1862, provided a relatively easy way to accumulate the total costs for a responsibility center or "project" during the year.[21] Assuming that each project was under the control of a specified individual, such as the mine agent or the stamp mill superintendent, the cost accumulation account could have been used both to monitor total expenditures and to evaluate the performance of the manager. This control process seems to support the conclusion of Johnson and Kaplan [1987, p. 9] that the nineteenth century

> . . . management accounting information developed to facilitate the management of process-type industries: textile and steel conversion, transportation, and distribution. The management accounting measures were designed to motivate and evaluate the efficiency of internal processes, not to measure the overall "profit" of the enterprise. These organizations really had to do only one activity well: convert raw materials into a single final product such as cloth or steel, move passengers or freight or resell purchased goods. If they performed this basic activity efficiently, the organizations could be confident that they would be profitable in the long run. Thus, the management accounting system was created to promote efficiency in the key operating activity of the organization.

Both the Quincy Mining Company and the firms studied by Johnson and Kaplan pursued operating efficiency but there are two significant differences. First the accounting control procedures used by the Quincy Mining Company predated, rather than emerged from, the events that called for new management information. Second, whereas Johnson and Kaplan found that managerial information processes evolved independently, Quincy's management control activity was an integral part of the financial accounting system.

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[21] Fleischman and Parker [1991] list four areas of cost management observed in British industrial firms between 1760 and 1850: cost control techniques, accounting for overhead, costing for routine and special decision making, and standard costing. They attribute the development of cost control techniques to competitive forces in both the product and capital markets. The Quincy Mining Company's use of specific cost accumulation accounts may have been similarly motivated.

INTERDEPARTMENTAL COST ALLOCATIONS

Modern cost accounting procedures recognize the need for interdepartmental cost transfers when one department (or account) provides services for another. The Quincy Mining Company followed this practice as early as 1862 when accounts were established for the carpenter's shop and the blacksmith shop. Both of these were, in modern terminology, service functions. Costs (primarily labor, materials and recharges from other departments) were accumulated for each function and billed out monthly to users.

Costs from the carpenter's shop were distributed on the basis of a specified rate (shown in the journal entries that distribute the costs) times the hours (or days) charged to a user. In 1872, the first year in which sufficient detail is available to define how the rate was determined, total costs for the month were divided by the number of days recharged to all users to arrive at a daily recharge rate.

While the Day Book from the carpenter shop has not survived, an examination of Day Books from other functional areas indicates that company policy required supervisors to record the time and materials to be recharged in their Day Books. At the end of the month, the Day Book was given to the mine clerk, who prepared the appropriate journal entries to transfer the service cost to operating units.[22]

The Surface account provides another example of the company's concern for cost allocations. Individuals normally working for the Surface captain were occasionally assigned to other duties such as the carpenter shop or the farm and their time was then recharged to the user. In the limited instances when the journal entry listed the name of the reassigned individual, the recharge rate was simply his monthly wage divided by the 26 work days per month. This daily rate was then multiplied by whole or fractional days to arrive at the total amount recharged to the user. Since the Quincy managers were willing to absorb the time and expense of accumulating recharge data

[22] The Carpenters Shop account for January 1862 includes debits or charges for labor ($301.91) and supplies ($36.50). Recharges are made to the following accounts: Tram Road ($6.00), Surface ($204.91) and Mining Cost ($127.50) for a total of $338.41. In other months during 1862 recharges were also made to specific cost accumulation accounts. In each month the total charges to the account matched the total credits or recharges.

and manually recording the recharge entries, they apparently viewed more accurate departmental costing as beneficial.[23]

LABOR CONTROL

The successful cost reduction program implemented by the Quincy Mining Company after the Civil War was inextricably linked with the ability of the firm to control labor costs. A Foucauldian perspective suggests the Quincy management would have used the accounting system as a disciplinary tool to help control the activities and lives of the miners. But there is no direct evidence that the Quincy managers *used* the accounting system as a disciplinary tool. Yet there can be no doubt that the firm's accounting practices increased each worker's visibility and had disciplinary potential. For example, the Day Books for the period between 1861 and 1877 provide insights to the control exercised by the functional area managers. In a Day Book covering January through November of 1862, the mining captain recorded entries for monthly rent for housing for eighty-five individuals. A similar Day Book, kept by the Surface captain in 1870, contains a separate page for each laborer, that, in addition to recording the wages due, contains deductions for personal items such as firewood used and, in one instance, a used table purchased by a worker. A Surface Day Book from 1877 contains a $3.00 deduction from Joseph Kitt for a child's coffin and another $3.00 charge for a grave site. Taken as a whole, these Day Book notations suggest the minute details of the individual laborer's life were visible to, and monitored by, the company management hierarchy.

Perhaps the strongest implication the Quincy management actually monitored the individual workers is found in the employees' general ledger account balances. A sample of seventeen employee's accounts from December 31, 1867, was used to determine if the ending balances were debits (debtor) or credits (creditor). With the exception of two idle accounts (probably terminated employees) that had a zero balance, all of the ac-

[23] From a Foucauldian perspective the Quincy Mining Company had developed accounting procedures that could be described as "... a facilitative technology that enabled a whole range of activities of the person to be rendered visible and accountable" [Miller and O'Leary, 1987, p. 242]. The disciplinary potential of the accounting system was, in this instance, directed at the mine management through isolation and monetarization of their responsibilities.

counts had a credit balance.[24] All of the employee accounts were then reviewed to determine if any had a debit balance. There were none. The management hierarchy maintained the largest credit balances as shown below:

Mine agent	$455.95
Head captain	556.80
Mill superintendent	212.88
Captain	244.37
Captain	578.92
Mine clerk	88.50

From this observation, it is reasonable to conclude the credit balances were not a random occurrence.[25] The presence of a consistent pattern in the account balances, although unexplained by the available documentation, may reflect the organizational culture that existed in the paternalistic environment of the mining community.

Although undoubtedly a participant in the process of labor control, accounting processes may not have been the dominant force. Since the mine managers had unrestricted access to more drastic forms of disciplinary power such as termination of employment and expulsion from company housing, they may not have needed, or wanted, accounting data to inform their actions. Through a nexus of paternalistic social and cultural processes, the mine managers were able to exert sufficient power to control the lives of the labor force.

PATERNALISM

At Quincy and other Lake Superior mines, paternalism and social control were as integral to operations as the extracting,

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[24] The account balances in the sample were distributed as follows:

$0	2	$10-30
1		
$<1	6	$30-50
4		
$1-10	2	$>100
2		

The average monthly wage in 1867 was about fifty dollars.

[25] One interpretation of this phenomena is that the size of the balance in the account was somehow related to the status of the individual. The Quincy managers rewarded 'good' employees with relatively low cost company housing, preferred job assignments, promotions and pay increases. The annual reports of the company frequently refer to the desirability of a stable and loyal work force. Perhaps the maintenance of a credit balance was considered as a sign of fiscal responsibility and personal stability.

milling, and smelting of copper. Companies that came to a remote wilderness to start high-risk mining ventures had to serve as community builders. While developing underground operations, they also had to hasten the establishment of stable, livable mine villages.[26]

Pioneer mining companies arrived in advance of effective government on the Keweenaw peninsula, so they undertook "public" works projects on their own, such as the dredging of channels, the erection of docks and the improvement of harbors, and the building of roads. In their small, unincorporated villages, initially absent courts and constables, they set their own rules (such as prohibitions on the sale of alcohol), and when necessary they served as law enforcer, locking up a suspected thief, garnisheeing his wages to pay back a wronged party, or simply exiling him from the community.[27]

All the operating companies built dwellings. These tended to progress from very rude huts endured by initial exploring parties, to boarding houses, to log cabins, to framed, single family dwellings. Beside providing shelter, the mining companies engaged in food production and distribution. They slashed and burned away the forest, dedicating some cleared land for housing and reserving other acreage for agriculture. Besides operating a company farm, mining firms installed company stores at settlements, or encouraged independent shopkeepers to locate nearby and provision workers.

Mining companies brought the first resident doctors to the region and ran medical programs, whereby workers received treatment and medicine for a set monthly fee of $.50 for single and $1.00 for married men. Many companies, including Quincy in the late 1850s, opened a dispensary and hospital. They helped start other important social institutions such as churches, schools and lending libraries. As a mine venture matured and passed from an exploratory and developmental stage into a full-fledged production stage, it erected not only a complete physical plant at the mine proper, but also a well-rounded paternalistic community. At the mines, technology, labor, and life were all intermixed. When a company decided to enter into full produc-

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[26] Lankton [1991] provides a comprehensive analysis of the creation and operation of paternalism at the mines; see especially Chapter 9, "Homes on the Range;" Chapter 10, "Cradle to Grave;" and Chapter 11, "The Social Safety Net."

[27] The law enforcement function of the early companies is discussed in *Mining Magazine* I, 3 (Sept. 1853), 294-95.

tion, it acquired steam hoists and stamp mills. Simultaneously, it expanded its labor force and built new houses, stores, churches and schools.

Mining firms engaged in social constructions at a time when the area lacked other parties or agencies having the capital, interest, or responsibility to build up the infrastructure of a community. But these companies *remained* paternalistic after the necessity to do so had passed. Quincy, for one, sustained paternalistic practices throughout the nineteenth century because it saw them as an effective means of attracting, keeping, shaping and controlling its labor force.

The full range of paternal benefits, running from a free garden plot to an inexpensive or free burial plot, formed a web of "amenities" that a company like Quincy strung up to capture desirable workers. Quincy operated in a labor market where numerous mines offered very similar work and compensation. Quincy used paternalism to help it initially attract skilled underground and surface workers, those deemed important to the company's success. Paternalism was then to breed loyalty among these same men. Mine workers at the time were notoriously mobile; the workers in Michigan, after all, had *all* recently come from somewhere else. By withholding or delivering paternal prerequisites, Quincy might encourage some men to move along, while encouraging others to take root at the mine, to ride out the peaks and valleys of production and the highs and lows of compensation, and to finish out a workingman's career after many years, or even decades, of service.

Quincy's housing policies and practices, as documented by the firm's annual reports, provide a good example of how the company used paternalism to attract, shape and control labor. Through the mid-1850s, while Quincy remained a very speculative venture, it hired single men at its pioneer works and put them up in boarding houses. But as soon as it went into real production in the late 1850s, the company sought to reshape its labor force. In pursuit of stable, sober married men, Quincy cut back its boarding houses and started erecting single family dwellings. It also allowed new employees to build their own houses on building sites leased from the company at nominal rates.

In mid-1859, when it employed 211 men, Quincy still operated four boarding houses and rented out just 30 single family residences. By 1862, employment had risen to 588; the boarding houses had declined to one; the mine owned and rented out 95

single family houses; and 41 employee-owned houses stood on company land. By 1865, when employment reached 654 men, Quincy rented out some 200 single family dwellings.[28]

By the end of the Civil War, Quincy had more than three employees for each company house. Even after the post war employment decline, by no means could Quincy house all its employees. This housing shortfall was intentional. A company house was to be seen as a privilege awarded to select individual workers, after managers had scrutinized a set of personal characteristics, including skill, occupation, ethnicity, dedication, industriousness, and marital status. A house was not an entitlement born simply of employment. Receipt of a house signified to the employee that he was deemed one of the working-class elite, and the company expected that recognition to breed greater loyalty. And perhaps a worker made his greatest expression of loyalty and trust when he built his house on land still owned by his company. A restrictive ground lease might require him to move his house, should he quit the company or be fired. Such housing practices clearly encouraged (or coerced) employees to work and strive for the benefit of their employers, if they wanted to obtain a company house, or keep their own house standing on company land.

Paternalism, which at its heart was a discriminatory system, was overseen by managers who made decisions to house, hospitalize or otherwise help workers on a case by case basis. Mine managers intended for paternalism to act as check on worker behavior; to discourage rebellion and encourage compliance and cooperation. Paternalism also served as a check on the workers' cost of living. By helping control that, mine managers believed that paternalism helped them control labor costs.

Companies did not enter the housing business to make a profit. Typically, their houses rented for one dollar per month per room. Company owned housing was the cheapest available near the mines, and employee owned housing built on company land also offered an inexpensive housing alternative. Quincy used low rents and leased lots to offer strong competition to landlords in nearby Hancock, and thus to control housing costs in its vicinity. If housing costs could be kept low, thought the company, wages could be kept low.

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[28] Lankton and Hyde [1982] discuss company houses, the Quincy store and other paternal practices, pp. 35-38, 85-89.

Similarly, starting in the 1850s, Quincy rented a store property at the mine that competed with Hancock merchants about a mile away. This was not a nefarious company store of the type that gouged workers and trapped them in debt. On the contrary, by offering competition, Quincy intended for it to lower living costs at the mine. From 1864 through 1866 the mining company operated a store and sold provisions directly to its employees. It did so to counter war time inflation and put a lid on the upward spiral of food prices, as charged by local merchants. The store, with its lower prices, was to help the company hold on to its valued employees during labor shortages, and at the same time, discourage them from demanding higher wages.

Quincy and other major Lake Superior copper mining companies became known for paying relatively low wages, but for offering, at least to favored employees, a high level of paternal benefits. These benefits were to entice the best available workers to a company's employ, breed loyalty, and encourage long term employment. At the same time, they were to discourage poor, lackadaisical work; mute demands for higher wages; and limit labor agitation and strikes.

Finally, if and when hard times came, as they did at Quincy after the Civil War, paternalism guided the company's response as it rolled back employment and wages. The system, after all, defined for the company who its most valued, essential employees were. Quincy would let go of less skilled, single, short term employees. These were the itinerant workers that could be picked up again as needed. It would hold on to the skilled, married workers, the ones already in a company house, who formed the company's more loyal, essential core. These men could even be expected, if necessary, to absorb a wage cut, because they were supposed to be thankful to still have a job and a roof over their heads.

SUMMARY AND CONCLUSIONS

The accounting based control practices of the Quincy Mining Company can be broadly defined in two categories. The first defined the organization in terms of individual responsibility sets. Practices such as the use of specific ledger accounts for functional areas or short term projects, and interdepartmental cost transfers fall within this category. The second category reflects the firm's interest in, and knowledge of, the individual employee through the use of ledger accounts and day book in-

formation gathered and recorded by the low and mid-level managers. The combination of these accounting practices, the ability of the firm to influence the labor market, and the paternalistic environment of the mining community provided a comprehensive control mechanism that was sufficient for the information needs of the firm's management as they implemented a cost reduction program.

This study suggests that economic forces alone may be insufficient to bring about accounting innovations and provides evidence that other organizational and social influences may be more relevant. There are three characteristics of the Quincy Mining Company that may help to explain why accounting innovations were not needed. First, the Quincy Mining Company was a single product firm. As such, the firm was not subject to the complexities of inter-product cost allocations and the associated problems of multiple unit costs. Second, the firm used a relatively flat organizational structure.[29] Chandler [1977] found that as the organizational hierarchies of the railroads became more complex, accounting innovations were required to make financial information usable. In contrast, the Quincy management practices were based upon a more direct and personal involvement with the productive processes. Consequently, the post war economic crisis did not generate the need for new information to understand and rationalize the operations of the firm. Third, the Quincy Mining Company functioned within a strongly paternalistic social structure. This study has shown that the cost reductions observed after the Civil War were largely dependent upon the ability of the firm to control the cost of labor. Although accounting was a participant in the process of labor control, it was the strong paternalistic environment of the mining community that allowed the companies to dominate the labor force. Accounting innovations were not needed to increase the disciplinary potential of accounting processes because other, more effective, methods of control were readily available. Similar to Tyson [1990], this study concludes that accounting inno-

[29] The Directors of the firm consisted of a President, Vice President, Secretary, and Treasurer. The Mine Agent, supported by the Mine Clerk, was the top administrative official at the mine. Operational control within the mine was provided by the Head Mining Captain and various sub-captains. Both the stamp mill and smelter were run by Superintendents and foremen. See Lankton and Hyde [1982] for a more complete description.

vations, although feasible, were constrained by the social and cultural environment in which the firm operated.

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