Nova Scotia

Department of Education

Nova Scotia Museum Complex

Curatorial Report Number 58

Gold Mining and Milling in the Sherbrooke Gold District 1861-1906

Sherbrooke Village Restoration Project
Sherbrooke, Guysborough Co.
Nova Scotia

Researched and Written by:
Kathy Moggridge Kuusisto

Edited by:
Sheila Stevenson / Nova Scotia Museum

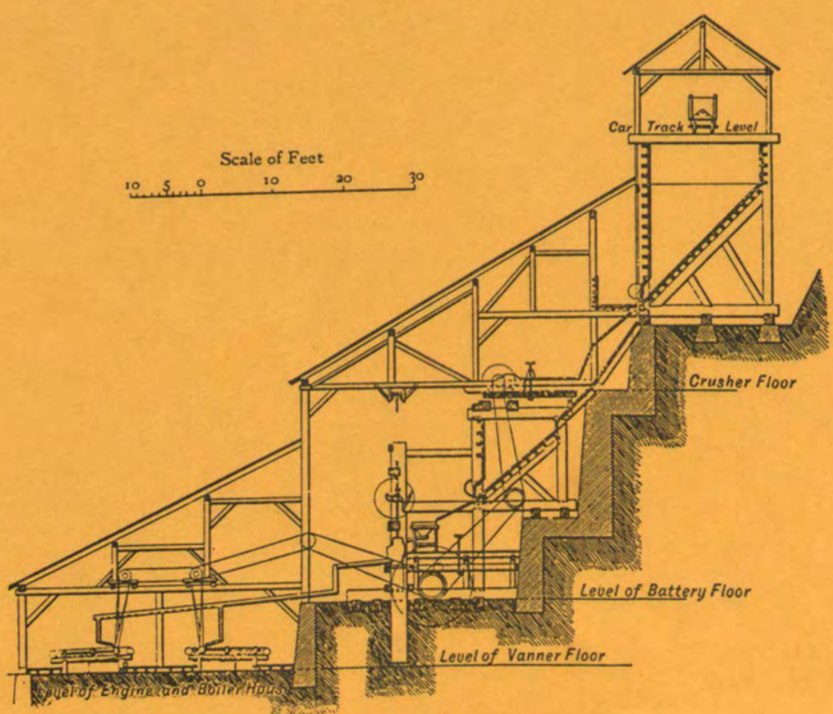

FIG. 67.

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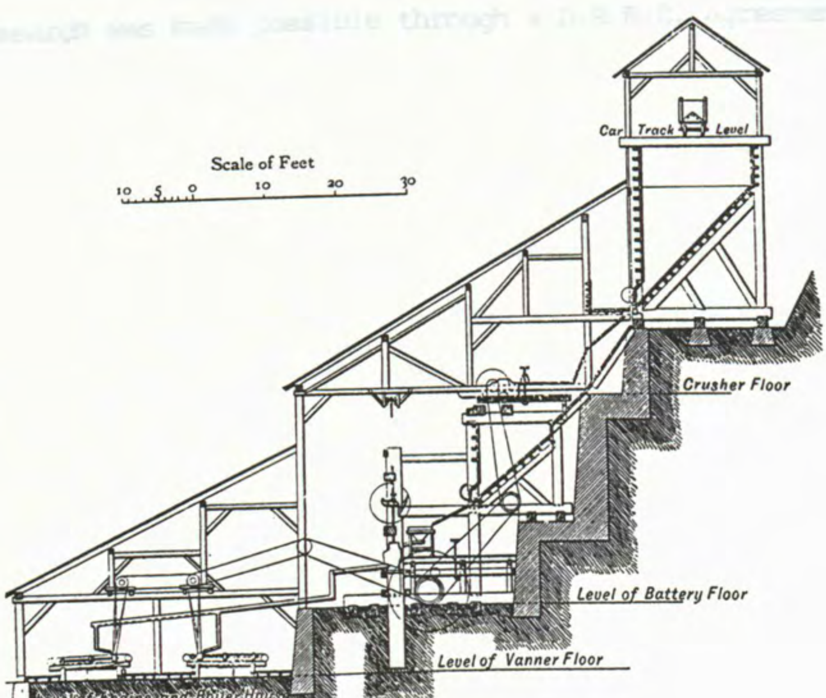

Fig. 67.

Nova Scotia Museum Complex

Curatorial Reports

Curatorial reports contain information on the collections and the preliminary results of research projects carried out under the program of the museum. The reports may be cited in publication but their manuscript status should be clearly indicated.

Background of this report

This illustrated report is the result of a twelve-week historical and architectural research program carried out in 1978 as a basis for the interpretation of the Sherbrooke District gold mining and milling story. The research was made possible through a D.R.E.E. agreement.

GOLD MINING AND MILLING IN THE SHERBROOKE GOLD DISTRICT: 1861-1906.

". . . the sound of stampers
may be heard, all hours, day
and night..."

Pictou Crusher, Goldenville
October 23, 1862. (Eastern Chronicle, New Glasgow)

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GOLDENVILLE

On the banks of Saint Marys river,
Stands a mountain grand and cold,
Placed thair by a bounties giver,
Filled with treasures manifold,
Treasures for which the world is waiting,
While the miners ply thair Skill,
Seaking to excell thair raiting,
In the camp of Goldenville.

While I thanked the bounties giver,
And watched the Silvery rippled tide,
Sliding down St. Marys river,
To the ocean deep and wide,
_______d hear the ceaseless pounding,
Of rock-breaker and Stamp-mill.
O're the hills and valleys sounding,
From the camp of Goldenville.

T'was evening and the Sun was setting,
O're lake and hill and mountain high,
And its golden rays were tiping,
The waves on the river flowing by,
As the gentle breezes waffed,
To my ease from o're the hill,
The merry Shouts and Joyous laughter,
Of the miners in Goldenville.

Laugh, yes work is but a pleasure,
To the miners after gold,
For when they see the golden-treasures,
Thair hearts pulsates with joy untold,
For thus thair labour is rewarded,
And farewell they know its worth,
For gold is king and will bring forward,
Brighter days of joy and mirth.

John A. MacDonald*
115 Kinnaird St.

* We do not know who John MacDonald was. This poem was found on the dump at Sherbrooke in the early 1970s.

Preface

A large portion of this report has been based on archival research and upon secondary materials about mining and milling methods used within Nova Scotia, Canada and the United States. In addition much was gained through conversations with former miners and millmen, and men who continue to prospect the gold fields of the province. I would like to thank particularly Wallace MacDonald, Edgar Horne, Gerald Logan, William Neily, Jim Leslie Jr., and Richard Durdle for the time and assistance they so willingly gave me in doing the background research for this report.

In addition, much of the report is based on photographs in the collections of the Nova Scotia Museum, Sherbrooke Village, and the Public Archives of Canada in Ottawa. Please note that the initials PA before a series of numbers refer to the National Photography Collection at the Public Archives of Canada and if any of these photographs should be used in an exhibit at Sherbrooke Village, the source must be identified.

K. Moggridge Kuusisto
Researcher
December 1978

1. Introductory Summary

The following report focuses primarily on the technology of gold mining activities in the Sherbooke Gold District during the latter half of the nineteenth century.

It identifies three periods of gold mining in Goldenville (i.e. The Sherbrooke Gold District): 1861-1872, 1873-1893, and 1894-1906. The report considers the techniques of shaft sinking, underground mining methods, drilling and blasting, as well as the milling and amalgamating methods employed during the first and third periods. Included within each of the above descriptions is a look at the physical structures and technology used.

The gold mining industry of Nova Scotia was marked by uneven development. Although it is difficult to find detailed descriptions of the structures and processes used in the earliest phase, it seems that the same type of buildings and methods were employed by independent miners or prospectors throughout the period 1894-1906. For example, the shaft structure at the Royal Oak Pit, 1861, ILLUS. 1 had not changed much over a thirty year period when compared with the small shaft houses, Crow's Nest, 1897 ILLUS. 47. Similarly the system of hoisting photographed in Goldenville c. 1920-1930, ILLUS. 19, and in Mount Uniacke, ILLUS. 35, and in Goldenville, 1897, ILLUS. 36, were not substantially different from the methods used during the earliest phase of gold mining in Nova Scotia.

Again, although larger-scale steam equipment was introduced into the various provincial gold fields after the 1880s, ILLUS. 20, miners (independent miners and those affiliated with large companies) continued to work with the primitive sledgehammer and handsteel, ILLUS. 43 & 45. The stamp mill did not change significantly during this forty-year period of mining although the number of stamps per battery increased, as did the weight of the stamps and the height of drop. A major difference in the mill would occur in the construction of the building. More care was expressed in using the surrounding landscape to the mill's advantage. They would build stronger mortar block foundations, and show more concern to construct a stronger building to withstand the continuous vibrations of the stamps.

Another difference would be seen in the power plants. During the 1860s the engines and boilers had a smaller capacity than those of the later period; similarly the structures designed to cover them appear to have undergone a change as well. ILLUS. 2, 3,& 24. Yet another difference between the earlier and later phases was the addition of concentrating equipment. During the 1860s there were few attempts made to treat the tailings in order to recover the fine particles of gold that had escaped battery amalgamation. After 1870 greater concern was expressed about the possible amounts of gold being lost, and many companies installed frue vanners, Wilfley tables, or at least blanket systems to recover the gold. The North Brookfield Mine built a substantial chlorination plant in the 1890s.

2. An Overview of Gold Mining in the Sherbrooke Gold District, 1861-1906

Gold mining in the Sherbrooke Gold District (Goldenville) can be divided into three separate periods; 1861-1872; 1873-1893; and 1894-1906. During the first eleven years after gold was discovered in 1861, claims were filed, companies formed and properties were consolidated. Mining properties were held both for the purposes of development as well as speculation. Between 1867-1869 (the peak period of activities in Goldenville) there were 19 companies listed in the area and 9,463.9 ounces of gold were recovered from 7,378.01 tons of crushed quartz.[1] However, by 1871 few of those 19 companies remained in operation; the Goldenville returns were dominated by only six companies. In 1872 production fell substantially. Many of the claims were taken up by the tributers, that is, individual miners and prospectors, who worked the properties for a rental fee.[2]

Throughout the following twenty-year period, mining properties continued to be worked in Goldenville, although not on the scale of the late '60s. Gold production did not return to the 1867 levels either in Goldenville or elsewhere in the province. The tribute system predominated in the gold fields of Nova Scotia much to the dismay of the provincial Department of Mines. Since most tributers worked with a minimal amount of capital on a short-term lease system, little care was given to the protection of the mine areas. Shafts were left uncovered; trenches were left to fill with water; no plans of mining activities were made or kept.[3]

In the early years of the 1890s the reports of Goldenville mining activities were filled more with concerns of local farmers losing their stock in the unprotected, abandoned shafts and trenches. At the end of this mining hiatus, Goldenville was described in the Halifax press as being virtually abandoned, and little more than "a straggling village" surrounded by an unattractive landscape of shafts and trenches and piles of waste rock.

It was not until the middle of the 1890s that full scale mining operations returned to Goldenville in a substantial way. Improved mining methods, technology and information provided by the Geological Survey of Canada topographers and geologists made it appear feasible to exploit the low-grade ore that earlier had been deemed unprofitable. Canadian, as well as American, capital returned to Goldenville in 1894 to develop the abandoned leads, as well as to discover new and more profitable veins.

End Notes

1. W. Malcolm, Gold Fields of Nova Scotia, (1st edition, Ottawa: Government Printing Bureau, 1912) p. 236.
2. Ibid, p. 229-230; N. S. Report of the Department of Mines, (hereafter cited as RDM,) 1872 (Halifax: Citizen Publishing Co., 1873) p. 22-23.
3. N. S. RDM, 1897, (Halifax: Queen's Printer, 1880) p.9; N. S. RDM, 1884, (Halifax: Queen's Printer, 1885).
4. N. S. RDM, 1891 (Halifax: Queen's Printer, 1892) p. 30; The Critic (Halifax) 6 March 1891; 30 January 1891.

3. Phase One; 1861-1872: The First Eleven Years

3.1. Discovery, Exploration and Development, 1861-1872.

Gold was discovered in what was to become the Sherbrooke Gold District[1] in late August 1861, by Nelson Nickerson, a Guysborough County farmer, while he was making hay in fields about a mile and a half west of the North West Arm of the St. Mary's River. However, it was not until October of that year that the news of Nickerson's discovery leaked out beyond his own family. By October 18, 1861, over 200 people had arrived in the district to stake their claims.[2]

The Sherbrooke discovery followed similar finds in Nova Scotia: Tangier (1858), Oldham (1861), Wine Harbour (July 1861), Stormont (September 1861) and Waverley (August and September 1861).[3] A surveyor was immediately sent for to lay out the mining areas and to receive applications for leases. Sixty-nine claims were filed for "Class 1" areas by March 1862; an additional 411 claims had been filed by the following December. A large number of these claims had been worked up for speculation and were never worked.[4]

The response to the gold finds in Sherbrooke District was very similar to what had happened in other gold districts of Nova Scotia. Spurred on by the gold rushes of California and Australia, people flocked to the gold fields of this province with expectations of instant wealth. Within a year of Nickerson's discovery, the once-empty lands were filled with dwellings and stores; Goldenville was a thriving village.[5]

However, the gold of Nova Scotia was not to be recovered from the earth as easily as that of California. It was not through a simple method of panning and washing that the gold nuggets would be recovered, but rather a systematic method of quartz mining was required.[6] There was considerable optimism about the ease with which shafts could be sunk and the ore mined. In February 1862 the following communication was sent to S. P. Fairbanks, about developments in the Sherbrooke Gold District:

> ...facilities for mining and exploring are very good - the ground being dry, and the surface of the rock but slightly covered with soil. The quartz veins are numerous, within a belt about 500 yards in breadth, and occupy the planes of bedding of strata that are nearly vertical; so that shafts can be put down vertically on the veins, to a great depth - which must prove of considerable advantage.[7]

The district appeared to be so rich that gold could be seen in the soil following a rainfall:

> ...this cannot fail to prove a gold field of extraordinary value - indeed gold has already been found on this band, four miles to the Eastward of the diggings, but no work of any consequence can be carried on there, until the return of spring.[8]

Between 400 and 500 men were working in the Goldenville diggings in May 1862. Already there was disappointment among the miners about the extent of their returns from the quartz. Many men had left the district by the following July. Their departure was a consequence both of low returns and the upcoming hay harvest.[9]

Not only had the miners misjudged the nature of the Nova Scotia gold deposits, so had the officials of the colonial government. In 1862 the mining claims were laid out in areas measuring 20 feet by 50 feet and 150 feet by 200 feet, both of which were too small to facilitate quartz mining methods. In addition to there being insufficient space to erect the necessary buildings and gear, the claims were laid out in close proximity to one another, thus creating problems of drainage and insufficient wall supports underground.[10]

The summer of 1862 was marked by depression in the gold industry. However, the following years saw a change in policy both by the government and mining operators. The size of claims was increased and companies began to consolidate claims to provide larger working areas. Within the next few years the numbers of mine-claim lessees declined, although the number of areas worked increased.[11]

During this early period the gold was extracted "by means of the simple hand hammer and other ... rude appliances". Trenches, 15 feet long by 8 feet deep, were dug along the vein and the quartz extracted. Then, by means of a hammer, the quartz was broken apart and the nuggets or crystals were picked out by hand.[12] Such crude mining methods could be used by small groups of miners, but were inefficient and expensive. In May and June 1862 the first ore crushers arrived in Goldenville.

In reports from Goldenville throughout June 1862, there was considerable speculation as to when the first of five crushers would be in operation. The greatest problem facing the mill operators was the condition of the road between the Goldenville wharf and the gold diggings, and thus the problems of transporting the imported crushers.[13] One of the first crushers to be erected was that of A. D. MacDonald. It was on the diggings in late May, but was not operational until mid June.[14] Two others were under construction: one owned by an American company and another owned by "an English Company". A total of five crushers was expected to be installed in the Goldenville area in the month of June, 1862.[15]

The crushers brought into the Sherbrooke Gold District during this early period were manufactured in Nova Scotia as well as the United States. McDonald's crusher, known as the "Pictou Crusher", was cast by a Mr. Mitchell, Halifax; Alexander Archibald's crusher was built by the William H. Davis foundry in Pictou.[16]

The general impression of Goldenville to visitors during the summer months of '62 was one of bustling activity. There were trenches everwhere as well as numerous shafts with a varity of structures built over them.[17] ILLUS. 1. However, the miners, many of whom were farmers either local or from Cumberland and Pictou Counties, were deemed to be generally inexperienced in the field of quartz mining. A group of Cornish miners imported to Goldenville by one of the larger outfits argued that a great deal of money had been wasted, especially on shaft construction.[18] In spite of the disappointments and the inexperience of many of the miners, several well-defined lodes had been discovered and shafts up to 60 feet deep sunk.

Table 1: Leads and Production Levels, Goldenville 1862

	Depth	Max. Yield Gold/Ton	Average Yield Gold/Ton
the Cumminger	20 feet	2 1/4 oz.	1 1/2 oz.
the Hayden	30 feet	7 0z.	3 1/2 oz.
the Aikens	30 feet	7 oz	1 1/2 oz.
the Drysdale	30 feet	8 oz.	2 3/4 oz.
the Blue	40 feet	9 1/2 oz.	4 3/4 oz.
the Hewitt	60 feet	12 oz.	4 oz.

Source: W. Malcolm, Gold Fields of Nova Scotia, (1st. edition; Ottawa: Government Printing Bureau, 1912) p. 227.

Table 2: Sherbrooke Gold Returns, 1862

Quartz Raised:	861 tons
Quartz Crushed:	861 tons
Gold/Ton:	2.023 ounces
Crushers:	3 steam - powered Mills; 1 water - powered Mill
Average of Men Working/Day:	72 miners

Source: A. Heatherington, "Annual Summary, Sherbrooke Gold District", The Mining Industries of Nova Scotia, (London: Turber, 1874).

The height of the activity in the goldfields in the summer months of 1862 was followed by a depression. Disappointed miners who had neither the technology nor the capital to mine their small claims, or whose claim prevented making adequate returns, left the fields. Over the next few years larger operations were begun as individuals leased a number of adjacent mining areas to carry on a more economical mining operation.[19] The New York and Sherbrooke Company, capitalized by Carlos Pierce and L. Sisen and incorporated in New York in 1864, acquired 40 mining properties which included approximately 25 lodes. The Wellington Mining Company, incorporated in December 1866 in Boston by C. F. McClure, controlled nine acres.[20]

The Wellington Mining Company and The New York and Sherbrooke Company erected their own mill houses, as well as housing for their miners.[21]

With the larger amount of capital raised through American or Canadian shareholders (selling stocks at $1 a share) these companies had the ability to develop their holdings more systematically. In 1874, Alex. Heatherington, a mining entrepreneur, was able to write about Goldenville, "The Mines ... have been opened up more systematically than in many other districts, the credit of which belong in a great measure to having more experienced agents in charge."[22] By 1864 gold mining had become a settled business in the Goldenville District. Some of the older mines which had once been worked and then abandoned as being worthless were opened up once again.

The year 1867 marked the peak of production throughout Nova Scotia's gold fields as well as that of the Sherbrooke district.[24]

In the 1868 Report of the Chief Commissioner of Mines, the Goldenville mines were described as being the most extensively worked operations in the province. The Wellington's main shaft extended 280 feet down; the hoisting shaft on the Hayden and Derby lode continued to the 110 foot level.[25] Among the companies working the Goldenville properties that year were:[26]

the Wellington Co.	the Meridian Co.
the New York and Sherbrooke Co.	the Chicago Co.
the Delta Co.	the Canada Co.
the Dominion Co.	the Coburg Co.
the Palmerston Co.	the Caledonia Co.
the Metropolitan Co.	the Woodbine Co.
the Kingston Co.	the Crescent Co.

(See also map #1: Sherbrooke Gold District, 1870)

The period 1867 - 1869 was one of speculation rather than of substantial mining activities. Although there were 19 companies recorded in operation in Sherbrooke in 1869, only four operations produced 85% of the returns. The following year only five companies worked throughout the full season, while 18 operations worked during the months of August and September.[27]

Table 3: Production - Sherbrooke Gold District 1862 - 1873

1862-73.—GOLD YIELD OF NOVA-SCOTIA.—1862-73.

SHERBROOKE DISTRICT.

...otal.	YIELD OF GOLD. Sources. From Quartz.	Native.	Average. Per 2240 lbs. of Quartz.	Per 100 lbs. of Quartz.	Annually per Miner. Value at £4 stg. per oz.	MINERS. Aggregate Number.	Daily av. for Year of 312 working days.	QUARTZ. Raised. Total Colonial Weight.	Per Man Daily.	Crushed. Total Colonial Weight.	Daily.	MILLS. Steam.	Water.	Total.	MINES.	Year.
												At the End of the Year.				
dwt. gr.	Oz. dwt. gr.	Oz. dwt. gr.	Oz. dwt. gr.	Grs.	£ s. d.	No.	No.	Tons. cwt.	lbs.	Tons. cwt.	Tons.	No.	No.	No.	No.	
0 0	2,023 0 0	....	2 12 15	56·390	112 7 10	22,464	72	861 0	76·6	861 0	2·7	3	1	4	0	1862
14 12	3,276 14 12	28 0 0	1 1 6	22·767	132 3 10	31,200	100	3,451 2	221·4	3,454 2	11·1	4	1	5	0	1863
14 20	3,409 14 20	10 0 0	1 8 14	30·615	130 15 10	32,630	105	2,673 0	163·8	2,673 0	8·5	4	1	5	12	1864
1 21	3,424 1 21	....	1 10 13	32·718	185 14 4	23,010	74	2,511 14	218·3	2,511 14	8·0	4	0	4	8	1865
13 8	5,829 13 8	....	2 5 18	49·030	323 9 10	22,490	72	2,853 11	253·8	2,853 12	9·1	4	0	4	12	1866
18 0	9,463 18 0	....	1 8 17	30·798	328 9 4	35,958	115	7,601 13	422·9	7,378 1	23·6	5	0	5	10	1867
0 5	7,070 0 5	....	0 15 23	17·173	148 4 0	59,540	191	10,130 10	310·0	9,880 4	31·6	9	1	10	13	1868
11 16	5,546 11 16	....	0 10 19	11·571	164 19 0	41,964	135	11,298 11	538·5	11,500 11	36·8	9	2	11	17	1869
4 0	7,131 4 0	....	0 14 9	15·529	187 9 4	48,880	157	11,428 5	467·6	11,428 5	36·6	9	2	11	13	1870
19 7	6,579 19 7	....	0 10 15	11·375	161 9 4	50,856	163	13,882 19	516·0	13,882 16	41·5	9	3	12	12	1871
9 21	4,188 9 21	....	0 17 21	19·173	136 13 6	38,246	122	5,213 0	274·2	5,213 0	16·8	9	3	12	10	1872
0 4	5,026 0 4	....	0 15 16	16·783	199 7 6	31,160	101	7,187 0	456·9	7,187 0	23·0	9	3	12	7	1873
7 18	62,972 7 18	38 0 0	0 17 21	19·166	177 5 0	438,698	117	79,125 8	360·7	78,853 5	21·0	9	3	12	7	Total.

Source: A. Heatherington, Mining Industries of Nova Scotia, (London: Turber, 1874)

Properties at this time bought and sold at inflated rates which had little connection with their mineral resources. Stamp mill returns were padded, inflating the potential value of the property and the companies' stocks. The durability of some of the companies which formed to exploit Goldenville's mineral resources can be illustrated by an examination of Malcolm's summary of operations and by listing the dates when companies began and ceased operations:[28]

Wellington Co.	Inc. 1864	1872 operations ceased;
N. Y. & Sherbrooke	Inc. 1863	1872 taken over by tributers; closed 1873.
Delta Co.	Inc. 1868	1869 discontinued;
Dominion	Inc. 1867	1871 discontinued;
Crescent	Inc. 1868	1869 Feb., discontinued;
Palmerston	Inc. 1866	1872 discontinued;
Metropolitan	Inc. 1868	1869 ceased operations;
Kingston & Sherbrooke	Inc. 1868	1869 little work done;
Meridian	Inc. 1868	1872 prospecting other properties;
Chicago	Inc. 1868	
Canada	Inc. 1868	1869 limited operations;
Coburg	Inc. 1868	
Caledonia	Inc. 1868	1869 ceased;
Wentworth	Inc. 1868	1869 sold to other interests;
Stanley	Inc. 1869	1869 suspended work;
Hamilton	Inc. 1870	1872.

This period of rampant speculation continued until the early years of the 1870s. Production levels never returned to the heights of the 1867 period, and the industry did not recover from the effects of the heady speculation on the American and English stock exchange until the 1880s. Goldenville did not recover until the mid - 1890s.

The American Journal of Mining depicted the hundreds of companies that had played the mining game in the Nova Scotian gold fields in this manner;..

> ...[the companies were] shining examples of the [penny - wise and pound - foolish]. They had money enough to waste, but none to spend. Heavy salaries to incompetent officers, large bonuses to speculative brokers, immense prices for underdeveloped and worthless mines, were within their legitimate outlays: but such expensive things as thorough mining engineers, efficient business agents, upright and faithful lawyers, they could not afford to maintain.[29]

One by one, the mining claims were leased to tributers. At first the Department of Mines argued that such a manner of operating the mines would be more efficient and profitable. Their reasoning stems from the early returns of the tributers' operations: in Goldenville, although the tonnage of ore crushed declined by 62% (13,882 in 1871 to 5,243 in 1872), gold production only fell by about 34% (6,579 to 4,188.4 ounces). However, in the 1879 Mines Report the system was roundly criticized.[30]

Throughout the remaining years of the 19th century, countless theories were developed to account for the rapid rise and fall of the Nova Scotia gold field. A.R.C. Selwyn put forward the following reasons in the 1870 - '71 Geological Survey of Canada Report:[31]

1. The rash expenditure of capital in purchase of mining rights respecting the actual value of which nothing is known with certainty.
2. The hasty and inconsiderate erection of costly machinery for mining and treating the ores, before their quantity or their profitable value has been determined.
3. The attempts frequently made to enhance the value of stocks by declaring dividends, sometimes paid out of capital, but often by means of a process commonly known as 'picking the eyes out of the mine', or in other words selecting all the rich materials to secure a few high yields which are far in excess of anything likely to be the future value.

4. The too-common almost-universal practice of devoting the whole of the net proceeds to the payment of dividends, and having no reserve funds to meet expenses when poor ground has to be worked through...

5. The small size of the 'areas' or claims, not as regards actual acreage, but in relation to the position and thickness of the veins. This necessitates a wasteful multiplication of shafts and plants of machinery for crushing and dressing the ores...

6. The disregard of the natural features of the ground, shown in locating the crushing and dressing machinery without reference to the easy delivery of the material from the mine and the fall required for the perfect treatment of the ores, and for getting rid of the tailings...

7. The almost universal want of any appliances for saving pyrites and fine gold.

Three additional reasons were put forth by H. Y. Hind:[32]

1. Frequent incompetency of some of the so-called mine managers.
2. Ignorance of mine managers regarding pay streaks.
3. Neglect to preserve records and plans of work done, which are absolutely necessary for acquiring a knowledge of the ore-shoots.

The above reasons for failure in the gold fields were not limited to the operations of the 1860s.[33] Practices were not seen to change dramatically in the future either.

END NOTES

Discovery, Exploration and Development

1. The Sherbrooke Gold District lies in Guysborough County two miles west of Sherbrooke. See W. Malcolm, op. cit., p. 224. In the Eastern Chronicle June 19th, 1862 the following description of the Sherbrooke district was printed: "...beginning at the north easterly corner of an old building formerly used as a saw mill, situated at the head of the North West Arm...; thence running north 65° west, or in a direction parallel with north and south boundaries of the mining lots laid out on this gold field three miles; thence southerly at right angles with the last mentioned three miles; thence eastwardly at right angles with the last mentioned line six miles; thence westwardly to the place of beginning three miles".

2. Harriet C. Hart, History of the County of Guysborough, Nova Scotia, (reprint, Belleville, Ontario: Mika Publishing Company, 1975),p. 171; Industrial Advocate (Halifax), v.III, n. 1, November 1897, p. 6; Alexander Heatherington, The Mining Industries of Nova Scotia, (London: Turber, 1874) (hereafter referred to as MINS), "Sherbrooke District - Gold Yield, 1862 - 1873", Heatherington attributes the discovery to a Miss Margaret MacIntosh in August 1861, while she was out gathering berries.

3. A. Heatherington, A Practical Guide for Tourists, Miners, and Investors and All Persons Interested in the Development of the Gold Fields in Nova Scotia, (Montreal: Lovell, 1868) (hereafter referred to as A Practical Guide...), p. 52 - 53.

4. W. J. Anderson, "Gold Fields of Nova Scotia", Transactions of the Literary and Historical Society of Quebec, New Series, Part II, 1863 - 64, p. 44.

5. W. Malcolm, op. cit., p. 5 - 6.

6. A. Gilman, "The Gold Fields of Nova Scotia", Atlantic Monthly, 89; 576 - 86. Gilman noted that the nature of the Nova Scotian gold deposits necessitated the most scientific and systematic methods of deep quartz mining. A. Heatherington, A Practical Guide..., p. 105: "Nova Scotia is essentially the Rich Man's Diggings..." Heatherington argued in his 1868 report that Nova Scotia gold mines could only be developed with machinery and skilled labour. The Halifax Sun, 25 July 1862.

7. Public Archives of Nova Scotia (hereafter referred to as PANS) RG 1, v. 462, Document 31. John Campbell's report to S. P. Fairbanks, February 1862.

8. Ibid.

9. Eastern Chronicle (New Glasgow), 8 May 1862. The reporter notes that there is already considerable disappointment about the mining returns of Goldenville, but still there is optimism: "Great things are expected from the crushers..."

10. The government gold mining policy appeared to present many problems to prospective miners. The government demanded a regular fee for the property claim as well as a 30% royalty on the gold recovered. The annual rent posed a problem for some of the early miners at Goldenville who described themselves in the following manner in a petition to the Gold Commissioner:

> ...[We] are still deterred owing to the want of a proper system for sifting gold from quartz - from making sufficient tests, to decide as to the value of claims, and whereas your Petitioners have undergone a considerable outlay in erecting Houses, in the purchase of mining implements, and labour in searching for lodes, after having paid the first installment, would now as such claims are to be confiscated, upon which the second installment is not paid as, the same becomes due, pray that the claims be allowed to remain in the possession of the original holders until they have a sufficient opportunity to decide to their values."

Dated 18 July 1862 and was signed by 149 individuals in Goldenville. PANS, RG 1, v. 465 1/2, Document 129. B. Silliman, Report on the Property of the Halifax Gold Mining Company, (Boston: 1864), p. 18 - 19; A. Gilman, op. cit., p. 583 - 84.

11. W. Malcolm, op. cit., p. 6; G. Evans, "Early Gold Mining in Nova Scotia", Collections of the Nova Scotia Historical Society, v. 25, 1942, p. 32 - 33.

12. Anonymous, The Gold Seeker's Guide, A Practical Directory in the Search for Gold, especially in Nova Scotia. (Yarmouth: H. Huntington, 1862) (hereafter referred to as The Gold Seeker's Guide), p. 15; Professor M. C. Vincent, Report on the Gold Property of the Tangier Mining Company, (London: G. W. Bacon & Co., 1866), p. 5.

13. Eastern Chronicle, 22 May 1862, reports that one crusher has been erected, but the road between the gold mines and the river leaves a lot to be desired. Ibid. 5 June 1862; The road to the diggings was reported as incomplete and expected to be ready in two weeks. Halifax Sun, 23 July 1862; the carriage road from the ferry terminates at Messrs. Elliot and Gunnison.

14. Eastern Chronicle , 22 May 1862; 5 June 1862.

15. Ibid, 5 June 1862; 19 June 1862 reports that only one crusher was working on the 'diggings' and there was another, owned by Joseph Oulton, four miles away on the river. Three other crushers were to be erected when the road was complete. The three crushers were owned repectively by American, English and Nova Scotian companies.

16. It is difficult to accurately match crushers with companies and/or individuals. The Halifax Sun, 23 July 1862 identifies the McDonald Crusher as being manufactured by Mr. Mitchell, Halifax. The 25 July, 1862 issue of The Halifax Sun identifies McDonald's crusher as the 'Glencoe Crusher', while the Eastern Chronicle (New Glasgow) calls the mill owned by J. McDonald and Alexander McDonald the 'Pictou Crusher'. In the Industrial Advocate's list of provincial crushers, Alexander Archibald is noted as the owner of the Glencoe Crusher while J. McDonald owned the Pictou.
In spite of this confusion over provenance it does appear that at least two crushers in Goldenville during the 1862 season were manufactured in Nova Scotia. See Eastern Chronicle (New Glasgow) 23 May 1862; The Halifax Sun 23 July 1862.
The W. H. Davis Foundry was founded by William Davis, Albion Mills, then moved to Pictou in 1855. See Our Dominion and Commercial Sketches of Halifax and Environs, (Toronto: The Publishing Company of Canada, 1887) p. 128.
It would appear that Mitchell's foundry was the same operation as the Chebucto Foundry, later known as the Nova Scotia Iron Works. See Hutchinson's Directory, 1864 - '65, p. 173 - 591, Belcher's Almanac 1868, p. 205.

17. Halifax Sun, 23 July 1862; W. J. Anderson, op. cit., p. 44.

18. Halifax Sun, 25 July;1862; Eastern Chronicle (New Glasgow) 19 June 1862 "Letter from Sherbrooke".

19. G. R. Evans, op. cit., p. 32 - 33; W. Malcolm, op. cit., p. 6.

20. Heatherington, A Practical Guide ..., Appendix III; T. S. Hunt, Report on the Gold Region of Nova Scotia, in Canada: Sessional Papers, n. 75, Ottawa, 1868, p. 29.

21. Ibid.

22. A. Heatherington, MINS; See also Nova Scotia Journals of the House of Assembly, Mines Report, Appendix 4, p. 2.

23. A. Gilman, op. cit., p. 586; Nova Scotia Journals of the House of Assembly, (hereafter referred to as JHA), Mines Report, Appendix 3, p. 4.

24. Malcolm, op. cit., p. 228 - 29.

25. Report of the Chief Commissioner of Mines for the Province of Nova Scotia, 1868 (Halifax); see also, JHA, 1868, Mines Report, Appendix 4. Inspector's Report, p. 25.

26. Malcolm, op. cit., p. 227-230; Eastern Chronicle (New Glasgow), 1 February 1868.

27. Ibid, p.229; American Journal of Mining (AJM), v. IX, n.8, 22 February, 1870, p.116. The AJM reported that "the 1867 gold mania" had collapsed during 1869. At Sherbrooke, the Wellington Mine had stopped in the summer of '69. The lode they had been working had been fully exploited to the limits of the property. An English Company was reported to have taken over the property for $60,000.

28. Ibid, p.228-230. "Inc." refers to date of incorporation as reported in A. Heatherington, A Practical Guide.... He does not always include the dates that companies began and ceased operations.

29. G. R. Evans, op. cit., p.33; See also W. Malcolm, op. cit., p.6. The AJM comment is rather interesting. It appears to assume that most mining companies of this period were more concerned about their operations than their apparent value on the stock exchange.

30. Malcolm, op. cit., p.236; RDM, 1872, p.22-23; also Malcolm op. cit., p.7: "In 1872 a great change took place in the system of mining; operating by companies was almost completely discontinued, and the system of working by tributors was introduced, became very general, and was the chief system in vogue for a decade." N.S. RDM, 1879, p.9; AJM, v. XV, n.19, 13 May 1873, p.297. See also J. C. Murray, "Gold Mining in Nova Scotia", Transactions of the Canadian Institute of Mining and Metallurgy, v. XXIX, 1926, p.3-4.

31. Quoted in W. Malcolm, op. cit., p.6-7. The rise and fall of so many companies in the pursuit of Nova Soctoan gold mining resources prompted mining entrepreneurs such as A. Heatherington to begin or conclude their comments on the wealth of the resource and its potential, with such phrases as no chimera. In his A Practical Guide, p.11, Heatherington also used Selwyn's report to reassure investors about Nova Scotia mineral resources:

> All those points are affirmatively answered by Mr. Sewlyn's admirable report; for although he hedges his remarks with the advice that 'no one should invest in such enterprises to an amount beyond what he can afford to lose without serious embarrassment,' the facts personally and officially testified to by him demonstrate that the auriferous quartz veins in Nova Scotia are abundant, likely to extend to a great depth, and, with skill and economy, ought to be mined at considerable profit.
>
> By avoiding the mistakes of previously organized undertakings, there appears, then, to be, better colony than in the distant foreign countries where, within the past two years, nearly as many millions of British capital have been irrecoverably lost in wild speculations.

> Let us hope that a change is about to take place, and that Englishmen who uphold legitimate mining enterprise will cease to neglect the now well-proved advantages of a British dependency for chemical allurements abroad.
>
> The formation of a company for consolidating the principal gold claims in Nova Scotia, and developing them under British energy and methods, besides evincing patriotic spirit, appears to be actually a necessity. Such a project, under respectable administration would, we opine, not only receive substantial encouragement from the investing public, but, if conducted on the basis of Mr. Selwyn's views, assuredly became both a paying and lasting institutions.

32. Quoted in Malcolm, op. cit., p.7.

33. The correspondence between R. V. Neily and J. B. Neily, (June 1914 to December 1914) attests to the continued practice of gold mining concerns depending on the returns of the stock market rather than the mine operations. PANS, Goldenville Mining Company Correspondence.

3.2 Gold Mining Technology and Methods: Phase One, 1861-1872.

The early years of gold mining in Nova Scotia were marked by inexperienced miners and primitive techniques of gold extraction and recovery. Capital investment, at first, was limited and most attempts to mine the auriferous mineral were restricted to digging trenches with cheap tools.[1] However, it was realized before long that the most efficient and profitable way, if not the only way, to exploit the gold districts was through quartz mining.[2]

Shafts were sunk on an angle, following the dip of the lead. They were usually rectangular and measured approximately five feet by twelve feet at the mouth. The width and height of each shaft and tunnel varied form operation to operation, lode to lode. However, some shafts were sufficiently wide and high to accomodate an ore wagon to transport the ore. The single compartment shaft served for hoisting the ore, for moving miners in and out of the mine , for pumping gear and for ventilation.[3]

Usually more than one shaft was sunk on a vein and each successive shaft was deeper or shorter than the preceeding one, depending on the pitch of the ore body.[4] The individual shafts sunk by a company or group of miners would be connected with one another by means of drifts or galleries. Once the shaft had reached the 60 foot level, horizontal drifts would be pushed out in either direction along the course of the lode. Similar drifts would be driven at the 120 foot level and the 180 foot level as well.[5] In 1868 the Sherbrooke and New York Company had sunk a dozen shafts, five of which were connected by drifts. The depth of the principal shaft was 170 feet. The main shaft of the Wellington Company in Goldenville extended down to the 500 foot level in 1872. Operations had to be discontinued in this mine because the available machinery was not sophisticated enough to service that depth.[6] Most mine shafts in the province did not exceed the 100 foot level during this early period.

Shaft sinking was done by hand. Machinery for drilling shafts was not used in the province until after the early 1880s. Even then, many of the miners were reluctant to give up their hand steels for an air or steam drill.[8] Dynamite was not used at this time to expedite the tremendous amount of work involved. Shafts would be sunk either on contract or by day labourers. The Fraser Company at Sherbrooke contracted out their one shaft on the eastern side of the St. Mary's River in 1862. In 1866 the Ophir Mining Company contracted the sinking of their shaft out at $8 per vertical foot. They also paid $5 per linear foot for drifting the mine.[9]

The structures erected over the open shafts were usually little more than shanties and provided the essential means of protection from the elements of nature. ILLUS. 1, "The Royal Oak Pit, c. 1861", depicts one such shaft-cover at Goldenville. It was a frame building with a pitched roof, and an entrance wide enough to facilitate the removal of ore in a wheelbarrow. Similar structures were scattered across the Goldenville landscape in 1869, according to illustrations 2 & 3.[10]

During this period of goldmining, the ore was usually hoisted up from the mine usually by manpower or horsepower. A windlass would be erected over the mouth of the shaft which would be worked by two men, unless the depth was such to warrant the use of horsepower.[11] (ILLUS. 4 & 5) If there were no ladders in the shaft by which the men could descend and ascend, they, too, would be hoisted in a bucket, or "tub" as the miners called it, by means of a windlass. The use of horses in the early gold fields is suggested by the following returns from Sherbrooke:[12]

Table 4: Returns, February - August 1863, Sherbrooke Gold District

	Feb.	Mar.	Apr.	May	June	July	Aug.
en (total) :	110	102	100	95	115	90	85
ova Scotians :	104	92	90	85	106	..*	..
ther :	6	10	10	10	9	..	..
orses :	12	12	8	8	8	..	..
rushing Machines :	4	5	5	5	5	5	5

*Figures not available

Source: PANS, RG 1, v. 465 1/2, Documents 144, 148, & 182.

However not all the mining operations relied solely on horsepower or manpower to hoist the ore from the mine shafts. The Wellington Mine at Goldenville, one of the deepest operations in the province, employed a 20 h.p. engine to operate its hoisting gear and pumping equipment. In his 1868 report, John Rutherford, Inspector of Mines, noted the increased need for machinery to replace antiquated methods of hoisting ore as new depths were reached.[13]

It was only after the shaft had been sunk and several drifts had been pushed out that the work of mining was said to be begun.[14] The contents of the lodes were removed by successive steps, or <u>stoping</u>. Two methods of stoping were employed:

Overhead Stoping:[15]

> the working of a block of ore from a lower level to a level above;

Underhand Stoping:[16]

> the mineral is extracted from above downwards; that is, the stope may start below the floor of a level and be successfully horizontal sliced, either worked sequentially or simultaneously in a series of steps.

In the method of underhand stoping, blasts were made from the floor of the drift and all the material was hoisted to the surface where it was sorted. However, in the overhand method, the material was sorted in the drift and the waste was used to fill up space, sustain walls and facilitate the continuation of the work. However, since candles were the only source of illumination in the drift, it was difficult to sort the ore accurately and efficiently. Consequently there was a risk of losing richer fragments in the ore dumps. Although the underhand method was more expensive - in hoisting all the refuse to the surface - it was the method generally followed in most Nova Scotian mines.[17]

It was not until the 1870s that dynamite was introduced. In his 1872 report for the Department of Mines, Henry Poole strongly recommended its use in spite of its expense. The difference would be made up through savings in "the cost of drilling, charging, tamping, convenience in wet work, and effectiveness of blasts." Previous to the use of dynamite, black blasting powder was used in the gold mines.[18] (ILLUS. 6)

Three men (two strikers and a drill holder) would be employed to prepare the blasting hole "using an ordinary inch and one quarter drill". It would take a full shift for the three men to drill a sufficient number of holes which usually extended from 6 - 10 feet into the rock. Since the holes were rarely uniform the blasting cartridges had to be made by hand. According to George Stuart,[19] a 19th - century mining entrepreneur, the cartridge shells were covered with thick brown paper and common soap was used to make them impervious to water. The shells were not only made to fill the holes as drilled but were adapted as well to the condition of the rock.[20]

From Inspector Poole's remarks in the 1872 report for the Nova Scotia Department of Mines, it would appear that the blasting powder was not the most efficient substance. It did not break up the rock sufficiently and it threw the rock considerably in the drift.[21] A problem with blasting powder, as well as with dynamite, was the failure of a charge to go off at the proper time. Accidents involving blasting powder were not an uncommon feature of gold mines during this and later periods.[22]

Once the charges had gone off and the smoke was cleared from the mine, the next shift of workers - the muckers - would descend to remove the broken ore. The work would be done by hand, loading the ore in wheelbarrows to transport it to the shaft where the substance would be loaded and hoisted to the surface in the wheelbarrows as in illustration 1,[23] following page 32.

The equipment with which the miners worked underground was a varied collection of hammers, sledges, steels, tamping irons , crowbars as well as wheelbarrows and hoisting tubs. Such items were available from the local blacksmith shop or could be imported from merchants in Halifax.[24] (ILLUS. 7)

An 1868 prospectus of the Alpha Mining Company, Mount Uniacke Gold District, listed the tools owned by the gold mining company:[25]

12 picks
6 shovels
4 crowbars
24 drills
2 rock tubs
3 striking hammers
2 windlasses

In December 1869, the sale of the Eldorado Gold Mining Company at Wine Harbour was advertised in the Halifax Morning Chronicle. Among the articles were 1 gin house, 2 blacksmith shops, 1 shaft house, 1 set of cart harnesses and gin harnesses, set of blacksmith tools and mining tools, as well as "a lot of steel and iron"and a 100 chaldrons coals.[26]

The key fact to be noted about mining methods during this period was their uneven development and use. During the early months of mining in the province, the techniques of sinking shafts and extracting gold were primitive, to say the least. It was not long before companies consolidated mining properties and began to employ steam power to operate hoisting and pumping systems. However, the tools used underground continued to be simple hammers, picks, shovels, crowbars and handsteels. In the smaller operations if hoisting and pumping were necessary, they were performed by means of windlasses or whips; the same type of tools would be employed underground. A small primitive operation, owned perhaps by two or three local miners, could develop adjacent to a larger foreign - owned company that took advantage of the most recent technological developments. This continued to be the practice throughout the remainder of the 19th century as well as during the years of gold mining this century. (See ILLUS. 5)

END NOTES

3.2 Gold Mining Technology and Methods; 1861 - 72.

1. Eastern Chronicle (New Glasgow), 6 November 1862. A letter to the paper provided a description of how prospecting was carried out at Goldenville. It was done primarily "by trenching for leads ..." which was often haphazard. This combined with a general lack of capital often forced the prospective miner to abandon his mining activity. See also J. P. Messervey, "Miscellaneous Memos and Papers on Gold in Nova Scotia", (unpublished, 1934 - '41 Department of Mines) p. 1: The recovery methods were more or less hurried attempts "to locate rich ore shoots and work them to shallow depth with cheap tools and equipment and with as little capital investment as possible".

2. A. Gilman, op. cit.; A. Heatherington, MINS,

3. T. S. Hunt, op. cit.; N. S. J. H. A., 1877, Appendix 6, Mines Report, p. 67. The shaft at the Wellington Mine, the deepest in the province at that time, was used to hoist ore tubs as well as provide ladderways for the men. In 1876 a man on a ladder was injured when a plank of wood fell from the tub going up the shaft.
N. S. J. H. A. 1876, Appendix 6, Mines Report, p. 62. One of the shafts at the Wellington was sufficiently large enough to accomodate an ore wagon. On July 31, 1875, "a man 'contrary to orders' was riding on top of the wagon that was ascending the inclined shaft ...".

4. W. Malcolm, op. cit., p. 111.

5. A Gilman, op. cit., p. 584.

6. W. Malcolm, op. cit.

7. J. Outram, The Counties of Nova Scotia; their Conditions and Capabilities, (Halifax: A. Grant, 1867) p. 17; J. P. Messervey, "Miscellaneous Memos ...", p. 2. Messervey cites the average depth of most shafts as being 83.5 feet which he considered insufficient to work profitably. The general assumption about the gold deposits of the province was that they were superficial, so shafts were not sunk to any great depth.

8. A. A. Hayward, "Shaft Sinking" in Industrial Advocate, v. III, n. 7, May 1898, p. 10.

9. N. S. J. H. A., 1875, Appendix 4, Mines Report, p. 30 - 31. In 1877, Mr. McClure, a prominent mining entrepreneur in Nova Scotia, experimented with a "Victor Hand Power Borer" at Waverley but "as the drill requires ... at least a width of a three foot stope; it (was) suitable for only a few leads". The machinery available to miners in the '70s and '80s was so cumbersome and awkward to use that many miners preferred the lighter and simpler hand methods of working the rock.

See The Engineering and Mining Journal, v. XVIII, January 2, 1875 for examples of available mining machinery. Halifax Sun, 25 July 1862. Ophir Mining Company, The First Report of the Ophir Mining Company, Established at Renfrew, N. S., (Boston: J. B. Chisholm, 1866) p. 19. The shafts on the Ophir property measured eight feet and four and a half feet at the openings. The levels were four and a half feet wide and six feet high.
See also, W. J. Anderson, op. cit., p. 46.

10. ILLUS. 1, Royal Oak Pit, 1861. The original is an ambrotype owned by A. Lomaš, Sherbrooke, N. S. The structure is attributed to the Goldenville diggings.

ILLUS. 2, Goldenville, 1869, courtesy of Public Archives of Canada (hereafter PAC), National Photography Collection.

ILLUS. 3, Goldenville, 1869, Eastern Chronicle (New Glasgow) 1 January 1863: "Most of the pits are covered in from the weather with snug substantial shaft houses and every preparation is being made for carrying on the work during the winter".

11. S. P. Hunt, op. cit., p. 13.

12. PANS, RG 1, v. 465 1/2, Documents 144, 148 and 182. See also this report , following page 64, ILLUS. 36, (PAC53513, Prospecting Shaft, Mount Uniacke) ILLUS. 4. (PAC53510, Prospecting Shaft, Mount Uniacke Gold District) and ILLUS. 5. (PAC 14666, Country Harbour, Old Blair Property, 1934) for examples of horse - drawn hoisting devices. ILLUS. 4 & 5 follow page of this report respectively.

13. A. Heatherington, A Practical Guide, Appendix III, Wellington Mine; N. S. 1868 Report of the Commissioner of Mines for the Province, p. 29.

14. A. Gilman, op. cit., p. 584; Heatherington also quotes Gilman's description in A Practical Guide ..., p. 88 - 89.

15. Albert E. Fay, A Glossary of the Mining and Mineral Industry, (reprint, Washington: Government Printing Office, 1920), p. 481 - 82.

16. S. P. Hunt, op. cit., p. 13; Albert H. Fay, op. cit., p. 713.

17. S. P. Hunt, op. cit., p. 13; A. Gilman, op. cit., p. 584. According to Gilman, when the breadth of the lode was equal to that of the level, it was not material as to whether underhand or overhand stoping was used. However at Tangier, Oldham, and Montague, where the lodes were of moderate width and there was considerable rock to be removed, overstoping was employed "so as to give free passage to the mine". Blasts were made from the roof or 'back' of the drift, and the barren or dead rock containing no gold was left on the floor of the drift. The heaps of barren rock were used by the drillman to gain better access to the receding roof. Wallace Mc Donald, in an interview, described the same use of the barren ore during his days as a drillman at Ventures in Goldenville.

18. N. S. RDM, 1872, p. 23 - 24; "three men may still be seen laboriously preparing a hole for an ordinary blast, using at least an inch and a quarter drill" and black powder. Dynamite was not used in gold mines in the province prior to 1872. Even after that date the high cost of the material almost prohibited its use. The cost of freight material plus a high duty imposed by the government made it very dear. JHA, 1877, Mines Report, p. 30 - 31.

19. George Stuart was associated with gold mining in Nova Scotia from the early '60s until his death. He assisted his father in the construction of the first stamp mill at Waverley in the early 1860s. G. Stuart, "History and Outlook of Gold Mining in Nova Scotia" (unpublished paper, 1933), p. 1: "I helped my father to erect in Waverley the first gold stamp mill in Canada." See also, H. J. Morgan, The Canadian Men and Women of Their Time: A Handbook of Canadian Biography of Living Characters (Toronto: William Briggs, 1912) p. 1074. Stuart was born in 1842.

20. Stuart, op. cit., p. 32.

21. N. S. RDM 1872, p. 23 - 4.

22. Eastern Chronicle, (New Glasgow) 1 January 1863. A young man from New Brunswick who was working in the Renfrew mines lost both hands in a blasting accident.
A. Heatherington, A Practical Guide ..., p. 118. Another common accident was "the premature ignition of the powder while tamping for a blast.

23. W. McDonald, Oral Interview, November, 1978.

24. Belcher's Almanac, 1867, p. 184; Belcher's Almanac, c. 1865, p. 184; H. H. Fuller & Co.; Sherbrooke Village Commission File, Lester V. MacDonald, "The Gold Rush, 1861 - 1862, Sherbrooke Gold Mining District", (unpublished paper, n. d.) The McDonald blacksmith shop in Sherbrooke supplied a number of the gold miners working in Goldenville, Wine Harbour and Cochrane Hill with the necessary drills, hammers, tamping irons, crowbars, hoisting tubs, and wheelbarrows. John Angus McDonald, Ledger "C", 1856 - 1876.

25. Prospectus, Alpha Mining Company, Mount Uniacke, (1868), p. 13 - 14.

26. Morning Chronicle (Halifax), 10 December 1869, p. 3, col. 8.

3.3 Gold Milling Technology and Methods: Phase One, 1861-72.

Once the ore had been hoisted from the mine, it had to be sorted and crushed before it was milled to recover the gold. Tramways were built by some companies to transport the ore from the shafts to the mill building, but most often it was hauled by wheelbarrow or horse and cart.[1] Mills were not always located close to the mine. The availability of cheap labour was one factor that permitted millowners and mining entrepreneurs to build where they pleased.[2] In Goldenville two steam mills were built on the St. Mary's River near the wharf; both the Wentworth Mill and the Canada Mill were built in 1868. Two water mills, the Oulton Crusher and the McDonald Crusher were located on water systems beyond the diggings.[3] (ILLUS. 8)

According to T. Sperry Hunt's 1868 report for the Geological Survey of Canada (GSC), the mineral was taken directly to the mill to be sorted, "the barren portions rejected and the material reduced to fragments of proper size."[4]

It is likely, however, in the less cpaital - intensive operations that the quartz may have been crushed closer to the shafts. An 1869 map of the property of Messers. Tucker, Tobin and Canning at Oldham shows a quartz house close to three shafts, approximately 1800 feet from the crusher.[5] (ILLUS. 9) The small independent operations would have crushed their own quartz before transporting the pieces for crushing at the local custom mill.[6] To maximize the efficiency of the stamp mill, the 'ideal' reduced size for the quartz ore was a two-inch piece.

In the earliest phase of mining, the quartz was broken into smaller pieces with sledge hammers.[7] Crushers were employed by a few of the larger operations such as the New York and Nova AScotia Gold Company at Tangier, circa 1864. The quartz was pulverized in the stamp mill but was "first cracked by a machine which resembled a Blake's Stone Breaker".[8]

> "A multitude of crushers have been tried to break up the quartz before it is given to the stamps or other pulverizing apparatus, but the number in use is very small. Those principally in use consist of two heavy iron jaws, which are wide apart at the top and close together at the bottom, and as they work back and forth, the quartz is smashed between them. The quartz is usually in pieces not larger than goose eggs when delivered to the battery"...[9]

By the end of the decade mining authorities were recommending the implementation of stone breaking divices to reduce the amount of manpower and increase the efficiency of the mining operation.[10]

Once the quartz had been reduced to two-inch pieces or less, it was ready to be pulverized in the stamp mill. The stamp mill was used to facilitate two processes in the recovery of gold from quartz - pulverization and amalgamation. The design of the apparatus evolved from the 14th-century gunpowder mill and the 19th-century Cornish tin mine stamp mill.[11] (ILLUS. 10, 11, & 12)

Two types of mill were employed in the Nova Scotian gold fields: the Chilean mill and the Californian stamp mill, the latter having evolved from the former. The Chilean mill, used in Waverley in the early 1860s, was found to be a less efficient device for recovering small amounts of gold from large portions of quartz.[12] The Californian stamp mill was a far more popular choice amongst the miners and entrepreneurs.[13]

The anticipation of instant wealth, as well as the realization that a mill building improved the value of the gold property, was reflected in the number of mills that were constructed throughout the gold districts. By the end of 1862 there were thirty crushing mills; ten years later the number had grown to fifty-two, although no more than a dozen were in operation.[14]

There are few descriptions of the buildings that were constructed to house the stamp mills or crushing machines erected throughout the Nova Scotia gold districts at this time. One is that of the Alpha Company mill in the Mount Uniacke District. The eight-stamp mill constructed c.1868 was housed in a pine building that also contained sleeping quarters for the superintendent and his men. No physical dimensions of the building were provided in the properties.[15] The mill building erected by the New York and Nova Scotia Gold Company at Tangier was housed in a farm building measuring 40 x 50 feet, and was two stories in height. A boiler was annexed to the structure to house the two cylindrical boilers, each 28 feet long and 42 inches in diameter, which supplied steam to the steam engine.[16]

ILLUS. 2 and 3, of Goldenville, 1869, show a number of barn-like structures with substantial chimneys constructed of what appears to be bricks. Most of the mills within Goldenville were operated by steam engines, necessitating such a structure. The mills appear to be little more than wooden barn-like structures, with pitched roofs. It is difficult to determine the number of stories, the placement of windows or doors within these structures. Since no tramways appear in either photograph, the ore must have been transported to the mills by means of horse and cart or wheelbarrow. For the former, a substantial door must have been available.

The safest assumption that one could make about the mill buildings constructed during this period would be that they were crude, wooden structures which were not expected to last. The stamp mills were portable to some extent, and it was not uncommon for them to be dismantled and removed to another site.

Following is a list of Goldenville mill owners and their mills from 1862 until 1873:[17]

Licensed Mill Operator	Name, Location	Date Licensed*
A. Archibald	Glencoe Crusher Block 3.775	01/05/64 Surrendered
John McDonald	Pictou Crusher Block 3,798,802,831	01/05/63 Burnt
Zebale Hewitt	Hewitt's Crusher Block 3,793-4	01/05/63 Surrendered 23/09/76
Wm. Cunard	N. S. Land & Gold Block 3, 827	01/05/63 Surrendered
Zebale Hewitt	Glencoe Crusher	03/94/65 Mill dismantled
Zebale Hewitt	Block 3, 615	01/10/67 Surrendered
Stephen Goodall**	Block 3,785,786	18/04/68 Surrendered 07/05/69
Daniel Hattie	Block 3, 692,693	23/04/68 Dismantled
Stephen Goodall	Block 3, 781	01/09/68 Dismantled
Stephen Goodall	Block 3, 718	01/09/68 Surrendered 16/06/69
Stephen Goodall		10/11/68 Surrendered 16/06/69
Newell Snow	Palmerston Crusher	23/11/68
W. W. Kirkpatrick	Block 3, 781	26/01/69 Surrendered 10/05/70
R. W. Carson	Wentworth Crusher	19/06/69 Dismantled
Ira I. Twist	Chicago Crusher Block 3, 795, 796, 827	01/07/69 Left Country
Jesse Cumminger	East Side Glenelg Lake	24/08/69 Surrendered
G. J. Dickinson	Dominion Crusher Block 3, 715	11/07/70 Surrendered
Henry M. Hamilton	Hamilton Crusher Block 5, Sherbrooke 31-2	15/12/70 Surrendered 20/12/72

Licenced Mill Operator	Name, Location	Date Licenced*
Ira Twist	Block 3, 807	07/06/71 Dismantled
	Concentrator or buddle, Block 3, 807	
George Hamilton	Block 3, 781-2	24/04/73

*Date of licensing was usually after the mill had been constructed. Also, mill licence had to be renewed, so duplicate names do not necessarily mean different mill operations.

** S. Goodall was manager of the Dominion Mine; (S. P. Hunt, op. cit., p. 30.)

This early period of activity corresponded to the development and increased use of steam power in the province's manufactories.[18] In Sherbrooke the majority of the stamp mills in use between 1862 and 1872 were steam powered, even though this form of power was more expensive.[19]

Table 5: Stamp Mills, Sherbrooke Gold District, 1862 - 1872

Year	Stamp Mills		
	Steam	Water	Total
1862	3	1	4
1863	4	1	5
1864	4	1	5
1865	4	0	4
1866	4	0	4
1867	5	0	5
1868	9	1	10
1869	9	2	11
1870	9	3	12
1871	9	3	12
1872	9	3	12

Source: A. Heatherington, MINS, "Gold Yield of Nova Scotia, Sherbrooke District", 1862 - 1873.

The engine used in the steam stamp mills ranged between 10 and 15 horsepower. The 16-stamp Wellington Mill in Goldenville was operated by a 15 horsepower steam engine and was capable of crushing from 16 to 20 tons of quartz per 24-hour period. The Palmerston's 10-stamp mill could crush 10 tons per 24-hour period with its 10 h.p. steam engine.[20]

As mentioned, the mill most commonly employed in the Nova Scotian gold fields was the Californian stamp mill. Although mills were imported from the United States,[21] it was not long before local foundries began to advertise "quartz crushers on the most improved plan" in the province's newspapers and directories. Among the foundries producing gold mining mills and equipment were W. H. Davis in Pictou; the New Glasgow Iron Foundry owned by W. and J. W. Fraser; Isaac Matheson and Company, New Glasgow; Sibley, Caffrey and Company, Truro; Thomas Mitchell, Halifax; Henry Dimock and Company, Windsor.[22] (ILLUS. 13 & 14)

Following is a description of the type of mill that had evolved by the late 1870s:[23]

> [ILLUS. 15] represents the ordinary Californian pattern of stamp mill. The stamp is a cylindrical iron pestle faced with a chilled cast iron shoe, removable so that it can be renewed when necessary, attached to a round iron rod or lifter, the whole weighing from 600 to 800 lb. The lift is effected by cams acting on the under service of tappets a, and formed by cylindrical boxes keyed on to the stems of the lifter about one-fourth of their length from the top. The bed or mortar A is cast-iron. The height of the lift may be between 8 and 10 inches, and the number of blows from 30 to 90 per minute.

The early mills in the province did not match the above prototype exactly. At first, the mortar boxes were constructed of wood with a heavy plate of iron fitted into the base. The stamps were often cast iron, although there was a gradual move toward the use of steel shoes and dies.[24] The material used in the stamp stem also changed during that period from wood to wrought iron. One contemporary writer argued that the best mills had iron rather than wooden lifters.[25]

Another variation in the Nova Scotian mills was the arrangement of stamps in each battery. In the Californian mill there were generally five stamps per battery, while here there were a number of mills employing an arrangement of four stamps.[26]

Ophir Mining Company, Renfrew (1864)
16 stamps;

Wellington Mining Company, Goldenville (1868)
4 batteries of 4 stamps each;

Palmerston Company Mill, Goldenville
single battery of 4 stamps, and
2 united of 3 stamps each;

New York and Sherbrooke Mining Company, Goldenville (1864)
8 stamps;

Hayden and Derby Mining Company Mill, Goldenville (1868)
15 stamps.

Toward the end of the decade many mills were using the five stamp arrangement.[27]

There was also variation from mill to mill in the weight of stamps employed, as well as their height and rate of drop. Stamps weighed from 525 lb. and the height of drop varied from ten to fifteen inches. The rate of strokes per minute per stamp was from 50 to 75. These variations reflected the variety of opinions among gold mining interests about the most efficient means of exploiting the stamp mill.[28] The function of the mill to pulverize the quartz was agreed upon; however, there would appear to have been a divergence of opinion about the amalgamating capacity, and the best way to exploit it.

Another modification in the mills in the province was the shape of stamps used:[29]

> There are two systems of stamps in use in Nova Scotia - those with square heads and those with round and rotating heads ....

This variation was a reflection of the origins of the contractor (or owner) of the mill facility. The mills were erected by either American or British concerns, each of which had their own preferences. The American system was designed so that the cam not only lifted the stamp stem but rotated it slightly on its axis. In the English system, evolved from Australian gold fields, stamps were square and non-revolving. Gradually the American design predominated throughout the province.[30] (ILLUS. 16)

The crushed quartz was fed into the battery and then, during the stamping operation,

> a quantity of water sufficient to aid the pulverization and amalgamation, and to carry out the pulverized mineral, is supplied to each stamp by means of tubes furnished with stop-cocks. In front of each battery is a rectangular opening which is closed by means of a frame or movable sash, covered with a fine screen or grating, the liquid mud formed by the pulverization of the mineral under water, and projected from the boxes by blows of the stamps, passes out and flows out over a series of fixed or oscillating tables, slightly inclined, and placed one below the other, at different levels, before being covered as waste or refuse to a place of deposit without. The metallic gratings in front of the batteries have generally from 160 to 200 holes to the square inch. The finer the grating the less the amount of material stamped in a given time, but the more complete the treatment.[31]

The addition of water to the battery facilitated the pulverization as well as the amalgamation, However, in these early mills, the water was added above the dies at the top of the mortar box. (ILLUS. 15). Adding it at this level caused the spaces between the dies to become fully packed with the crushed material and thus hindered the complete operation of the battery system. In addition, the arrangement of four stamps per battery, rather than the three or five stamp system, did not assist the movement of the crushed quartz throughout the battery.

As a result the stamp mills were not operated at their potential level.[32]

The failure to fully exploit the capacity of the mill was a consequence of the poor level of metallurgical skills and interests of the mining concerns in the province.[33] Although most operators would agree that the mill was a means of thoroughly reducing the quartz, few appeared to understand how it could best be used to facilitate amalgamation. This was reflected in the debates about the degree of fineness to which the quartz should be placed at the battery opening, the use of mercury in the battery, and the addition of water. Opinions varied about these issues and various practices resulted.

In many mills the grating which supported the metallic screen at the face of the battery was fixed in a vertical position, although "a slight inclination outwards, to favour the escape of the pulverized matter..." was to be preferred.[34] The angle not only assisted the movement of the mud out of the battery, it also reduced the wear of the screen by causing the particles of ore to be forced from under the stamp at a smaller angle.[35]

Related to the angle of the gratings was the degree of fineness to which the ore ought to be pulverized.

> The finer the grating, the less the amount of material stamped at a given time, but the more complete the treatment. I am inclined to believe that many of the mill workers, not taking into account the smallness of the particles of gold, do not pulverize to a sufficient degree of fineness.[36]

However, another 1860s writer argued that if the ore was crushed too fine, the finer particles were more likely to be carried away with the water and to escape amalgamation altogether.[37] Writers later in the century argued that the quality of the ore determined the degree to which it should be pulverized:

> An ore, the main richness of which lies in its sulphurets, should be crushed comparatively course, so as to avoid reducing the valuable sulphurets to slimes, which are difficult to save and treat subsequently. If the sulphurets are finely disseminated, the ore must be crushed more finely than when they are in coarser crystals, so as to facilitate their separation from the worthless gangue, the object being to produce a minimum of particles that can consist partly of sulphurets and partly of quartz; obviously the minimum size of the crushed particles must therefore be somewhat less than that of the valuable particles in the original ore.[38]

Mercury was added to the battery at regular intervals to facilitate the amalgamation process, although from the writings of Hunt, Stillman and others it would appear that this was not a universal practise.[39] However, by the middle of the decade the addition of mercury to the stamp battery had become a regular part of the mill man's job. At the Ophir Gold Mine in Renfrew, a spoonful of mercury was added to the battery at the beginning of the operation and then every four hours. Then, after a few days of working and depending upon the quality of the mineral, the quantity of mercury was increased or decreased.[40]

A problem encountered by millmen in the amalgamation process was "the sickening" or "flouring" or mercury - "that is, the particles, losing their bright metallic surfaces, are no longer capable of coalescing with or taking up other minerals."[41] Independently, an American and an Englishman discovered that the addition of a small quantity of sodium to the mercury would solve this problem. In March, 1866, Dr. George Lawson read a paper before the Nova Scotia Institute of Science outlining the use of sodium amalgam in recovering gold from ore high in arsenic pyrites. In September of that year, Lawson and Dr. Krackowizer, manager of the Lake Major Company Gold Mines ("the crusher and other machinery of these mines being much superior to those of any similar establishment in the province") experimented with the addition of the sodium amalgam. Dr. Lawson reported that the experiment on the tailings at the mines gave returns of the rate of five ounces per ton of pyrites.[42] In his report T. S. Hunt noted that sodium amalgam had been adopted to some extent in the provincial mines, but "has probably not yet received the thorough trial which it merits". Among the companies regularly employing it was the Wellington Mine in Goldenville.[43]

Much of the gold within Nova Scotia was coarse and "free milling" and could be recovered in the batteries with the addition of mercury.[44] A further amount was recovered through the use of copper amalgam plates arranged at the front of the stamp mill battery. The tables caught the amalgam that was flushed through the screen by the combination of the stamping action and the water force. The arrangement of tables varied from mill to mill. At the Ophir Mill in Renfrew, the following system was used:[45]

> The liquid mud from the pulverization, passing from the battery through the grating, flows over four fixed tables, placed one below the other. The first, or uppermost table is the shortest, and is trapezoidal in form; the dimensions of the two parallel sides being three and a half and two and a half feet. The three succeeding tables are rectangular, and have respectively the length of seven, eight and six feet; their breadths being twenty-four, fourteen and twelve inches.

In other mills, tables were rectangular or designed in the form of sluices or equipped with a series of riffles or transverse grooves containing mercury. Some mills had fixed or shaking tables that moved with either a lateral or back-and-forwards motion.[46] The tables at the Wellington Mine, "one of the best in the region", were fixed and designed in the form of sluices.[47] Both the New York and Sherbrooke and the Hayden and Derby mills in Goldenville were equipped with shaking tables.[48]

Almost from the beginning of this first period of mining there was concern expressed about the amount of gold that escaped battery amalgamation and flowed out of the mill with quartz tailings.[49] Although much of the gold in the province was free milling, it was "also intimately bound up with sulphides requiring other methods of treatment for recovery".[50] Professor George Lawson argued that the use of mercury alone was quite inefficient "owing to the presence of sulphides" which coated the gold and prevented the action of the mercury upon it.[51]

There were attempts in some mining operations to overcome these problems. One early method was the roasting of the quartz prior to pulverization. The New York and Nova Scotia Gold Company at Tangier built kilns in which to roast the quartz in order to drive off the arsenic and sulphides bound up with the quartz and gold. Silliman questioned the wisdom of this approach on account of its additional cost as well as the tendency of the quartz to become "friable" and more difficult to treat. In addition there was a problem in retrieving the gold from the pyrites after calcination.[52] This practise appears to have been abandoned by 1868.

The same New York and Nova Scotia Gold Mining Company installed a system of buddles "to concentrate the pyrites" in the mid 1860s, and there were attempts in the Sherbrooke Gold District to treat the tailings.[53] Many of the tributers who took over abandoned mining properties in 1872, following the collapse of the industry, worked the tailing dumps to recover whatever gold remained behind. Ira Twist continued to work the Palmerston mine and in 1873 installed a buddle and three tables, measuring eight feet by two feet wide covered with copper amalgam plates, each of which was terminated by a riffle. The tailings were mixed with water and passed through a revolving screen of one-eighth inch mesh. The finer tailings were then passed over the tables;

small jets of water were used to keep the tailings moving along the surface of the plates. By means of this system Twist was reported to have recovered 41 ounces of gold from 675 tons of tailings.[54]

However, by and large, systems were not installed during this early period to recover the gold that escaped battery amalgamation.[55]

Separation of the Gold from the Amalgam

At regular intervals the mill was shut down to allow the amalgam to be removed from the batteries and the copper-plated tables; is known as cleaning up the mill. The frequency with which the mill was cleaned-up depended directly upon the richness of the mineral.[56] Hunt noted that the Ophir mill batteries were cleaned once every two weeks, while the tables were cleaned once in three or four days, or even daily if the mineral was that rich. Following is Hunt's description of the process in one mill at Uniacke Mines:[57]

> This process... is effected by a stream of water from a hose, which removes the sands from the tables and allows the amalgam to be gathered up from the plates. For the batteries, the stamps being raised, and the grating removed, a jet of water is employed to break up the compacted mass of partially stamped mineral, which fills the box; the larger fragments being removed by hand, until the amalgam accumulates at the bottom. The dies are then cleaned and taken up, and the washed amalgam gathered into a mass, and added to that already obtained from the tables. The excess of mercury is then removed from this by pressing it in a chamois leather, or in a closely-woven wet cloth; after which the amalgam is divided into balls of proper size and heated in a cast-iron retort, which is previously lined with a paste of clay and water, to prevent the adhesion of the gold. The portion of mercury which still remains with the gold being expelled by heat, its vapours are carried over and condensed in water, and at the

"end of the operation the gold remains
in the retort in the form of spongy
masses, which are melted in a crucible,
and cast into ingots." (ILLUS. 17)

END NOTES

3.3 Gold Milling Technology and Methods: Phase One, 1861-72.

1. B. Silliman, Jr. Report on the Gold Property of the New York and Nova Scotia Gold Mining Company, with an Introduction to the General Structure and Geology of the Nova Scotia Gold Fields, (New York: George F. Nesbitt 1864), p.30. This company, located at Tangier, constructed a tramway to haul the ore from the hoisting shaft to the mill building.

2. A. Gilman, op. cit., p.583: The price of labour "rarely rises above a moderate $.90 per day." (1864). In Wine Harbour wages were 5 shillings per week in 1862, and the cost of conveying the material to and from the mines was cheap. In 1866 the rates at Goldenville were reported to be $1.00 per 10 hour day. AJM, v.1, n.19, August 4, 1866. A.R.C. Selwyn, "Notes and Observations on the Gold Fields of Quebec and Nova Scotia", Geological Survey of Canada, Progress Report, 1870-71, (Ottawa: Queen's Printer, 1872), p.281. The price of labour in Nova Scotia was estimated to be between $1.25 and $1.50 per day. In 1873, the closure of mining properties and the increase of the tribute system was attributed to the rising cost of labour. N.S. RDM, 1873. See also N.S. JHA, 1875, Appendix 4, Mines Report. Mills were also built to inflate the value of the mining property, thus location of the building was not always a primary consideration. See S.P. Hunt, op. cit., p.k2; W. Malcolm, op. cit., p.6.

3. The map "Sherbrooke Gold District" (PAC H2/219, ILLUS. 8, following page in this report) shows the Wentworth and Kingston and Sherbrooke Stamp Mills as being located on either side of the main Goldenville wharf. "General Plan of the Sherbrooke Gold District", in H.Y. Hind, Report on the Sherbrooke Gold District (1870), General Plan depicts the Wentworth and the Canada Mill in the above locations. In his 1870-'71 report, A.R.C. Selwyn attributes the failure of some mining companies to the tendency to locate mills without reference to the mine workings or the general landscape of the area. The Wentworth Company was sold at a sheriff's sale in December 1869 (AJM, v.IX, n.8, Feb. ww, 1870); neither the Canada Company nor the Kingston and Sher brooke Company worked for any length of time in Goldenville. W. Malcolm, op. cit., p.228. All the above mills were steam powered, rather than water powered, so they did not have to be located on the river.

4. T. S. Hunt, op. cit., p. 14.

5. Shelford and Robinson, Report on the Property of Messrs. Tucker, Tobin and Canning at Oldham, N. S. (London: Waterlow and Sons, 1869).

6. Anonymous, The Gold Seeker's Guide ..., p. 14"... the greater part of the gold obtained [at Tangier] has been extracted from the quartz by merely breaking it up with hammers, the fragments remaining on hand, to be afterwards ground in a quartz-mill..."

7. A. Heatherington, A Practical Guide ..., p. 111.

8. B. Silliman, op. cit., p. 20 - 21.

9. A. Heatherington, A Practical Guide ..., p. 111.

10. H. Y. Hind, Report on the Waverley Gold District, (Halifax: Annand, 1869) p. 54.

11. The 19th-century gold stamp mill dates back to the 14th-century and the production of gunpowder. It was not until the 15th and 16th centuries that such a device was used to crush gold ores. ILLUS. 10 is a drawing of "ancient mill"; ILLUS. 11 is Diderot's conception of the stamp mill used to recover gold from ore. The Cornish stamp mill, ILLUS. 12, was used in the 19th century tin mines and perhaps bears the closest resemblance to the mill employed in the Californian gold fields after 1849. Sources: Algernon Del Mar, Stamp Milling: A Treatise of Practical Stamp Milling and Stamp Mill Construction, (London: McGraw-Hill Book Co., 1912) p. 2 - 4; A. Diderot, Pictorial Encyclopedia of Trades and Industry, (New York: Dover, 1959, Paris, 1763.) Plate 137.

12. S. P. Hunt, op. cit., p. 13 - 14; B. Silliman, op. cit., p. 20 -21.

13. Encyclopedia Britannica, (9th edition Edinburgh: Adam & Charles Black, MDCCCLXXIX), vol. X, "Gold", p. 746 - 47. The Californian stamp mill was considered "the best method thus far developed in actual practice on a large scale for the treatment of auriferous quartz". Engineering and Mining Journal, (formerly the American Journal of Mining, AJM, hereafter cited as EMJ) v.10, n.12, December 13, 1872. In the 1 February, 1868 issue of the AJM there was a note from Nova Scotia about the general preference here for the Californian stamp mill.

14. The importance of mill buildings to the property's value, regardless of the gold production potential, was reflected in a dispute between V. Neily, Goldenville mine manager and J. B. Neily, the company's Boston president. Manager Neily recommended the sale of the additional mill building on the Goldenville property to raise capital to facilitate further developments underground. The president rejected the idea on the basis of the added value these buildings gave to the property, even though there was not enough gold coming out of the mining to support the operating costs. N. S. Department of Mines, Report OFR 1911, (Halifax, unpublished, 1911) p. 2; A Heatherington, MINS, p. 11.

15. Prospectus, Alpha Mining Company, Mount Uniacke, p. 12.

16. B. Silliman, op. cit., p. 44.

17. Industrial Advocate (Halifax), v.VII, n.5. March 1902, p. 8 - 9; v.VII, n.6, April 1902, p. 9.

18. Canada Census, 1870 - '71.

19. H. Y. Hunt, op. cit., According to this 1870 report it cost between $0.35 and $0.40 per ton of quartz crushed with water-power, including the interest on the capital cost of the mill, compared at $1.25 per ton of quartz with steam power.

S. P. Hunt. op. cit., p. 15; Prospectus, Ophir Mining Company (p. 10). They installed a light engine to power its 8 stamps to reduce the original cost of crushing. The company eventually installed a water-powered mill and enlarged its mill from 8 to 16 stamps. The prospectus stated that the new mill had dispensed with the cost of fuel, as water was available to operate day and night. Previous crushing costs ranged between $3.00 and $1.25 per ton.

20. T. S. Hunt, op. cit., p. 29 - 30.

21. Eastern Chronicle, (New Glasgow) 8 May 1862; A. Heatherington, Practical Guide..., p. 113. Heatherington had published a drawing of the 10-stamp mills produced by Moray and Sperry, New York, in his Halifax publication Mining Gazette. ILLUS. 5, following page of report.

22. Prospectus, Ophir Mining Company, p. 11; "... there are several Nova Scotia foundries and one or more manufactories of engines and stamp mills..." The prospectus pointed out that the cost of local products was less than those produced in New England.

Hutchinson's Directory, Nova Scotia, 1864 - '65, p. 621, 617, 173 and 591.
Hutchinson's Directory, Nova Scotia, 1866 - '67; p. 103.
Hutchinson's Directory, Nova Scotia, 1864 - '65; p. 621, 626.
McAlpine's Directory, Nova Scotia, 1870 - '71, p. 559, p. 50.
Halifax Sun, 23 June 1862. One of Goldenville crushers was manufactured by Mitchell in Halifax.

23. Encyclopedia Britannica, figure 5, p.747.

24. T. S. Hunt, op. cit., p. 13.

25. B. Silliman, op. cit., p. ; J. A. Phillips, Gold Mining and Assaying: A Scientific Guide for the Australian Emigrant, (London: John J. Griffin, 1853) p. 89 - 90. The lifters or stamp stems, used in the Australian mills described by Phillips, consisted of wood.

26. Prospectus, Ophir Mining Company, p. 7; See also Hunt's description of the water-powered mill built by Peter Montieth for this company at Ophir - T. S. Hunt, op. cit., for the mills at Goldenville.

27. W. Malcolm, op. cit.

28. T. S. Hunt, op. cit.
Mills constructed later on in the century were classified as heavy and light mills, according to the weight of stamps employed. The heavier mills with stamps of over 900 lbs. had shorter drops than the lighter stamps. Because of the nature of gold, there were problems in overcrushing the quartz and reducing the potential amount of gold recoverable.

29. See W. Malcolm, op. cit.; H. Louis, op. cit. p. 24.

30. B. Silliman, op. cit., p. 20 - 21. Messrs. Phillips and Darlington were named by Silliman as responsible for the English mills in the province. Phillips was most likely the same John A., the authority on gold mining in Australia. See T. S. Hunt, op. cit., A. Heatherington, op. cit., p. 109; Encyclopedia Britannica.

31. T. S. Hunt, op. cit., p. 14. In the mills used in the latter years of the century, the quartz was fed into the back of the battery, however Heatherington states that it was fed into the front of the mill in these earlier mills. See A Practical Guide ... p. 109.

32. H. Louis, op. cit., p. 207.

33. W. Malcolm, op. cit., p. 113 - 114.

34. T. S. Hunt, op. cit., p. 14.

35. A. Del Mar, op. cit., p. 20.

36. T. S. Hunt, op. cit., p. .

37. Morning Chronicle, (Halifax) 8 April 1862.

38. H. Louis, op. cit., p. 144.

39. Anonymous, A. Goldseeker's Guide ..., p. 36. The author writes the following about operations at the Tangier gold mines: "... mercury has not yet [1862] been used in separating the gold, either here or at other localities." B. Silliman, op. cit.; T. S. Hunt, op. cit., p. 15, 16: "... a wooden battery is preferable when mercury is used..."

40. T. S. Hunt, op. cit., p. 15 - 16, "The amalgamation of gold in the batteries during pulverization is adopted in most of the mills in Nova Scotia. This requires the introduction of mercury into the boxes at regular intervals..." In this 1868 report Hunt also quoted the following passage from Phillips' The Mining and Metallurgy of Gold and Silver to explain the procedure for the employment of mercury:

> "One ounce of gold required for its collection about an ounce of mercury; but when the gold is in a finely divided state, the addition of another quarter of an ounce is thought to be advantageous. The proper proportion is however, readily ascertained by watching the discharge, If any particles of amalgam, which may pass through, are hard and dry, a little mercury must be introduced, but if, [on the contrary, they be soft and pasty, or if] globules of mercury make their appearance, the supply to the battery must be diminished. When the proportion of mercury has been properly adjusted, the amalgamation of gold is completely effected... When the proper proportion of quicksilver has been regularly introduced, and the rock contains coarse gold, from sixty to eighty per cent of the gold saved is caught in the battery; but when... the gold is in a very finely divided atate, and is associated with ores of silver and other sulphides, the results are less satisfactory."

41. Encyclopedia Britannica, op. cit., p.748.

42. George Lawson, "On Some Recent Improvements in the Amalgamation Process for Extracting Gold from Quartz", Proceedings and Transactions of Nova Scotian Institute of Natural Science, v.I, Part 4, 1866, p.71-76.

43. S.P. Hunt, op. cit., p.18; H. Louis, op. cit., p.305-306.

44. W. Malcolm, op. cit., p.93; E. Gilpin, "The Gold Fields of Nova Scotia" (1882) p.17; H.Y. Hind, Report on Waverley Gold District, (1869) p.49.

45. T.S. Hunt, op. cit., p.16.

46. Ibid, p.16.

47. Ibid, p.29.

48. Ibid, p.29.

49. Eastern Chronicle, (New Glasgow) 26 June, 1862. The reporter covering the Wine Harbour gold fields noted in his dispatch"...the amalgamating process appears quite defective ... as tailings appear to contain much gold".

50. W. Malcolm, op. cit., p.93 and 112; H.Y. Hind, Report on the Waverley Gold District, (1869) p.49: "...66% of the gold is recovered when there are arsenical iron ores within the quartz". Hind attributed the loss of the remainder by the following factors:

    1) formation of spongy amalgam
    2) the gold was covered with a compound of the arsenic and thus escaped amalgamation.
    3) it escaped in arsenides and sulphides of iron.
    4) the gold escaped amalgamation as a result of being coated with grease from the miners' candles.

51. Professor George Lawson, op. cit.

52. Silliman, op. cit., (1864) p. 44.

53. Ibid. In the introduction to T. S. Hunt's 1868 report on the Nova Scotia gold fields, geologist A. Michel recommended the process of calcination prior to amalgamation. op. cit., p. 8.

54. N. S. J.H.A., 1873, Appendix II, Mines Report, p. 25.

55. H. Y. Hind,... Sherbrooke (1870) p. viii "... the concentration of tailings by means of Buddles, Blanket Strakes, ... is unknown ... and the use of long sluices to save floured mercury is not practised". W. Malcolm, op. cit., p. 112. The collapse of the gold mining attributed to the lack of technology to concentrate the tailings. There was not enough "free milling gold" available to make profitable returns. See M. Miller, "Men, Machines and Gold". (unpublished paper, c. 1977 - '78)

56. Encyclopedia Britannica, p. 748.

57. T. S. Hunt, op. cit., p. 16. The fire to melt the amalgam was made using alder in the earlier period, then coke. W. MacDonald, Oral Interview, 1978.

4. Phase Two, 1873 - 1893: Goldenville - The Interim Period.

Following the frenzied activity of the period between 1867 and 1870 - '71, large-scale mining fell off in Goldenville, as it did throughout the province.[1] Tributers took over many of the mining properties and worked them with apparent success during the early part of this period. The Wellington Mine, the deepest operation in Nova Scotia, closed down in August 1872 because "the machinery ... was insufficient for working the mine at that depth" and the owners were not willing to invest in heavier pumps and a more powerful engine. Another substantial operation, the Palmerston, was closed and the mining equipment was removed and applied to the development of new leads. Prospecting was carried out on many of the properties, and many men began to work the huge piles of waste rock.[2]

Foreign investment, principally American and English, declined after 1872. Rising labour and equipment costs, combined with the over-speculation of the earlier decade, made it difficult to attract new capital to the gold fields.[3] Mining operations were limited to smaller, less intensive modes of operation.[4]

With the exception of the years 1875-1877 and 1883-'84, gold mining did not return to earlier levels. Individual tributers such as Ira Twist, Israel West, and Zwickel dominated the mining and milling scene rather than companies.[5]

Crushers were built; licences surrendered and renewed; but not with the same frequency as they had been throughout the 1860s:[6]

James A. Fraser	Dominion Crushing Mill	07/02/74	
Daniel Hattie	Aquatable Crusher	24/11/75, 08/11/77	
James A. Fraser	Block 4, 13	08/11/74	
James A. McDonald	Miner's Crusher 100 feet N. road from Sherbrooke to Goldenville	12/01/78	Surrendered 06/11/94
Daniel Hattie	Aberdeen Crusher On road from Sherbrooke to Goldenville	10/09/78	
James Campbell	Cameron's Mill	16/12/78	
W. H. Ingersoll	Cumminger's Crusher	13/09/82	
Alex Cumminger	The Melrose Mill (formerly the Cumminger; Boston and Halifax)	12/10/85	Surrendered 26/01/87
Robert Fraser	Crow's Nest, St. Mary's River	07/01/86	Surrendered 30/11/94
John Williams	Pactolus Crusher	26/09/87	Surrendered 04/04/90
Brenton Symonds		21/09/88	
Alex D. Williams	Block 3, 742 - 3	04/03/90	Dismantled & Left Country

Although there was a revival of interest in gold mining in the 1880s, it was not until the next decade that Goldenville began to thrive again. Following the short - lived operations of the Pactolus Company, 1882 - 1884, practically all mining activity in this district was suspended.[7] Following are comtemporary reports on Goldenville mining activity:

> The trend of events during 1885, was decidedly backwards...[8]
>
> There was only a moderate amount of improvement visible during 1885...[9]
>
> From bad to worse is the record for 1889 ...[10]
>
> During 1890 this district had arrived to such a point of absolute neglect that its name is almost absent from the records of the Mining Office. No

> returns are given of any crushings nor are there any mining operators set down against its name.[11]

One writer observed and described the impact of the depression with these words:

> About eight years ago [c. 1888] the Sherbrooke District was just entering on the worse period of its existence. The large companies had ceased operations about two years previous to that date, and the ready money of the local capitalists had become very scarce, owing to unsuccessful tributing speculations. Many of the old plants had been dismantled, the Pactolus' companies' large water mill had gone up in smoke; and with the exception of two small engines and boilers, one on the Mayflower areas and the other on the Canada mine, the former "Premier gold district of Eastern Canada" was without engines or hoisting gear ... House after house was pulled down, became a ruin, numbers of families left the place altogether, and those who remained behind, either worked the dumps for what they could get or prospected for other people for any wages they could obtain. Many married men left their families, and sought work at Isaac Harbour, Fifteen Mile Stream, and Salmon River. Every now and then, some company would employ a few men for a short period of time, but these periods were few and far between; and the money spent invariably overran the value of the gold obtained.[12]

It is difficult to account for the decline in Goldenville throughout this period. A Halifax newspaper, The Critic, attributed the difficulties to the number of mining claims held by companies that were neither working them or allowing tributors onto them.[13] Other properties were rented but on terms that were not encouraging enough to foster development. Throughout the rest of the province, the renewed interest and activity was reflected in the formation of such bodies as the Nova Scotia Mining Society and the regular publication of journals such as the Canadian Mining Manual and a regular column on mining activities in The Critic.[14] However, it was not until 1894 that capital from outside was lured back into Goldenville, and another period of activity was underway.

END NOTES

4. Phase Two, 1873 - 1893: Goldenville - The Interim Period.

1. See N. S. J.H.A., 1872, 1873 and the 1875 Mining Reports for discussion of gold mining operators. Also G. R. Evans, Gold Mining in Nova Scotia During the 19th Century, (unpublished M. A. thesis, Dalhousie University, 1938).

2. See N. S. J.H.A., Mining Reports, 1873, 1874, 1875.

3. Ibid. 1875, Appendix 4. The problem of attracting capital to the gold fields was discussed in the House of Assembly, March 18, 1872. See E. C., March 28, 1872.

4. Ibid. 1875, 1876, 1877, 1878. Also, W. Malcolm, op. cit., p. 230 - 232.

5. Ibid.

6. Industrial Advocate (Halifax) v.VIII, n.6. April 1902, p.9.; v.VII, n.7, May 1902, p. 8 - 9.

7. N. S. RDM, 1891, 1893. The Critic (Halifax) 6 March 1891, 7 July 1893, 29 December 1893. The last report states that no mine in Goldenville had been able to pay its own expenses during the past seven or eight years.

8. Industrial Advocate (Halifax), v.VII, n.3. January 1898, p.8.

9. Ibid.

10. Ibid.

11. Ibid.

12. Industrial Advocate, v.I, n.1, November 1896. "Goldenville at the Present Day". p. 17.

13. The Critic (Halifax) 30 January 1891.

14. G. R. Evans, op. cit., p. 54. 1883 - '84 marked a re-awakening in the gold fields. Mines that had been idle were re-opened, and 1885 provincial production levels increased. B. T. A. Bell, Canadian Mining Manual, 1890 - 91, p. 40 - 41.

5. Phase Three, 1894 - 1906: The Return of Capital and an Improved Science and Technology.

5.1. The Return of Capital and an Improved Science and Technology

The year 1894 marked the beginning of a new era in Goldenville.[1] Ironically this same year was one of recession in other gold districts, reflecting economic difficulties in the United States, the source of much gold mining investment capital.[2] However, it appears that the source of capital for these late 19th-century developments in Goldenville was not the Unites States, but rather Nova Scotia, actually Pictou and Antigonish Counties. The Stellarton Gold Mining Company, The Springfield Gold Mining Company under the management of R. MacNaughton, as well as the activity of one John McQuarrie on the old Wentworth property brought welcome relief to the dullness of the previous years. In 1895 the New Glasgow Company began to develop some of the old properties. The following year, the Blue Nose Mining Company, organized by Thomas Cantley and other New Glasgow entrepreneurs, was incorporated and took over the claims of the Springfield, Caledonia, Woodbine and Coburg properties. Gradually the production of Goldenville returned the Sherbrooke Gold District to the important rank it once had held.[3]

In addition to the return of investment capital in the '90s, there was an improvement in mining technology. The period following 1883-'84 saw the introduction of more systematic methods of exploration and development, as well as improved mining and milling techniques. Sections 5.2 and 5.4 include discussions of new mining techniques and their impact on Goldenville operations.

The improved and more efficient methods of mining made it feasible to mine large quantities of low grade ores profitably. Previously, mining had been restricted to the 'rich, coarse' gold which was visible in narrow leads.

Table 6: Gold Production in the Sherbrooke Gold District 1882 - 1900

Year	Gold Extracted oz.	Dwt.	Gr.	Ore Crushed Tons	Yield Per Ton 2,000 lb. oz.	Dwt.	Gr.
1882	2,542	17	14	6,251		8	3
1883	3,356	18	17	8,470		7	22
1884	2,668	11	0	3,268		16	7
1885	1,738	11	0	2,426		10	2
1886	1,341	3	9	2,850		9	10
1887	585	3	5	2,413		4	20
1888	535	8	18	2,858		3	18
1889	243	17	17	1,618		3	0
1891	119	5	0	464		5	3
1892	179	8	20	893		4	0
1894	552	16	12	708		17	0
1895	1,942	2	0	3,397		11	10
1896	2,796	8	9	5,945		9	9
1897	4,181	18	19	12,659		6	13
1898	5,201	5	10	16,891		6	
1899	5,118	1	6	18,437		5	13
1900	4,763	12	9	17,711		5	9

No returns in 1890 and 1893.

Source: Malcolm, op. cit., p.183-4. Production, 1882-1900, Goldenville.

F.W. Christie, a mining engineer of the 1890s, compared the new to the old system of mining in the following manner:

> The development of ideas ... is illustrated by the change that is seen in comparing the workings of a mine in the earlier seventies with the workings that are now to be seen of later design. As the rich coarse gold was found in narrow main leads, this class was hunted for, the nature and value of deposits alongside was overlooked. A good example is illustrated by the sketch of the Lawson mine at Montague, where the workings were carried on in a lead four to six inches in thickness, giving as high as forty ounces to the ton, making

> an average as high as five and one-half ounces to the ton for the work of the season. The workings were carried down on the lead for 300 feet and along its course about 50 feet. This narrow width of quartz in this extent of workings yielded about $200,000 giving about $100,000 profit. On account of the difficulty of working such a narrow width of rock at the prices charged at that time for supplies and crushing, the work was stopped when the quantity of rich ore at the bottom decreased. Many mines worked in the earlier days on similar narrow leads, can now be worked by wider work reaching across several leads, or the quarry system of working by "open cuts" makes it possible to select the quartz at a profit, and handle very large quantities of so-called black rock.[4]

Another development that facilitated a more systematic method of mining was the extensive topographical survey work of the various gold districts by the Geological Survey of Canada (GSC) throughout the 1880s and 1890s. E. Rodolphe Faribault's summers of fieldwork for the Geological Survey provided interests with the necessary data to develop more systematic exploration methods. The work also paved the way for Faribault's theory of deep mining which substanially transformed mining methods.[5] (ILLUS. 18)

The earlier period of gold mining in the province had been marked by inexperienced miners and a technology that was, to some extent, still in its infancy. Channels of communications had been limited. Earlier discoveries had been reported with great detail in the Halifax and local newspapers but debates about latest techniques did not get the type of coverage that was available later to Nova Scotia mining interests in such scientific journals of the '90s, as Transactions of the Mining Society of Nova Scotia, the Industrial Advocate or even the Canadian Mining Manual.

Table 7: Gold Production of Nova Scotia by Districts, 1862 to 1896.
Arranged in order of value of production

District	Tons Crushed	Total Yield oz.	Dwt.	Grs.	At $19 Value $ ¢	Average Yield Ton oz.	Dwt.	Grs.
Sherbrooke	173,130	123,323	18	8	$2,343,154.42		14	6
Waverley	121,540	60,847	1	2	$1,156,064.03		10	
Oldham	45,100	48,990	10	18	$ 930,820.22	1	1	17
Stormont	80,316	42,313	19	13	$ 803,965.57		10	12
Salmon River[1]	95,601	39,373	7	18	$ 748,094.37		8	5
Caribou - Moose River	96,848	38,024	18	20	$ 722,473.10		7	20
Montague	21,696	37,894	1	19	$ 720,181.70	1	14	19
Uniacke[2]	50,656	35,683	12	8	$ 667,988.72		14	2
Renfrew	48,142	33,869	8	2	$ 643,518.68		14	1
Wine Harbour	42,711	29,140	8	7	$ 552,667.88		13	15
Lake Catcha[3]	20,734	22,257	1	20	$ 432,384.75	1	1	18
Tangier	42,720	20,192	17	10	$ 383,664.55		9	8
15 Mile Stream[4]	27,738	15,346	3	5	$ 291,577.05		11	1
Malaga*[SIC] ('89-'93)	18,567	15,180	5	8	$ 288,425.07		16	8
Brookfield[5]	14,360	11,534	5	4	$ 218,060.91		16	1
Rawdon[6], East -Central	12,158	9,592	7	4	$ 182,254.71		15	18
Whiteburn[7]	6,343	9,535	7	4	$ 181,179.98	1	10	1
Unproclaimed,- Other Districts	62,522	44,722	10	3	$ 849,727.67		14	7
Total to Sept. 30, 1896	980,882	638,322	12	19	$12,116,203.38			

Source: The Canadian Mining Manual, 1897, p. 117 - 1. from 1883; 2. from 1883; 3. from 1882; 4. from 1883; 5. from 1887; 6. from 1887; 7. from 1887; 8. from 1886.

*Molega

The contributions of local, as well as national and international, scientists and mining interests had been an important element during the early phases of gold mining.

However, during the decade of the '90s this element of participation increased.[6] Mining engineers and geologists participated on a much wider scale than previously. Schools of engineering had been developed at Queen's University in Kingston, McGill University in Montreal and Dalhousie University in Halifax. Both graduates and professors of the above institutions were actively involved in the development of mining activities in this later period. In addition, the methods of professional scientists of this period often produced more detailed records and plans than had been available earlier.[7]

In spite of all these apparent advances, the mining developments of the '90s were short-lived. The Blue Nose ceased operations in 1904 after extensive operations since 1897; the Royal Oak, formed in 1899, suspended work in 1906. Again, in the early 1890's, the provincial mining department received no reports of activities in Goldenville.[8] It is difficult to know precisely why operations ceased, especially after such a period of positive development and activity. However, the price of gold remained fixed at $18.00 per ounce although the costs of production had increased. In addition, the relationship between extensive underground and surface operations and actual gold production was not always a straight and narrow one. As had been the case previously, and would be again, much of this activity may have been a reflection of attempts to bolster the value of mining properties on the stock exchange more than an accurate reflection of the amount of gold being produced.[9]

END NOTES

5.1 The Return of Capital and an Improved Science and Technology.

1. G. R. Evans, op. cit., p. 110 - 11; Malcolm, op. cit., p. 232.

2. J. Morrison, Kejimkujik National Park: "We've Held Our Own", Manuscript Report Number 238, (Parks Canada, 1977) p. 78.

3. W. Malcolm, op. cit., p. 232 - 33; B. T. A. Bell, Canadian Mining Review, 1899, lists dates of incorporation and boards of directors for Nova Scotian mining companies.
   Geological Survey of Canada, Annual Report, v.X, 1897, Summary Report, p. 110A: "The district once a centre of much activity ..., has been little worked the past 15 years, but within a year or two abandoned properties have been re-opened and worked with satisfactory results." B. T. A. Bell, ed., op. cit., 1897, p. 117.

4. F. W. Christie, "Gold Mining in Nova Scotia", Industrial Advocate, (Halifax), XX, v.III, n.7 & 8, May and June 1898.
   G. W. Stuart, The Mining Number, 1903 (Halifax), p. 32. Stuart described the old system of mining as simply "following the single veins, taking out as little as possible, doing all the drilling by hand besides the quartz vein proper doing the blasting with charcoal or black powder."

5. W. Malcolm, op. cit., p. 14 - 18; See also Faribault's Map "Plan and Section of Goldenville Gold Mine District, 1897". Malcolm and H. C. Cooke, "Gold Deposits of Nova Scotia", (N. S. Department of Mines, Halifax), ILLUS. 18, in this report, p. 2; Geological Survey of Canada (hereafter referred to as GSC), Annual Report, v. XV, 1902 - 03. p. 422 - 23A.

6. Names such as Gesner, H. Y. Hind, Silliman, and Hunt dominated the reports of the earlier phase of mining - see W. Malcolm, op. cit., p. 13 - 14. During the later period many of the mining interests were often related to academic institutions such as John Hardman, professor of mining at McGill as well as President of the Nova Mining Society and of the Canadian Institute of Mining; F. H. Mason, a lecturer of metallurgy at Dalhousie; F. W. Christie, mining engineer; and professor E. A. Holbrook. See W. Malcolm, op. cit., pp. 14 - 15 and 311 - 319,; Wallace Dictionary of Canadian Biography, (Toronto: MacMillan Co. 1929) and H. Morgan, The Canadian Men and Women of Their Times: A Handbook of Canadian Biography of Living Characters, (Toronto: William Briggs, 1912).

7. GSC, Annual Report, v.X, 1897, p. 104A; W. Malcolm, op. cit., p. 16.

8. W. Malcolm, op. cit., p. 232 - 36; N. S. RDM, 1897 - 1910.

9. An examination of the correspondence between J. B. Neily, President of Goldenville Mining Company and R. V. Neily, local plant manager, reveals how much of the activity in the mine was not financed by the gold production but rather capital raised on the American stock exchange. Throughout the summer and fall months of 1914, there was not enough gold being

produced in the mine to regularly pay the mine's labour force. Neily Correspondence, May - September, 1914. File @ PANS.

5.2. Underground Developments

5.2.1 The Mine Shaft

It was not until the early 1880s that large-scale mining equipment was introduced into the Nova Scotia gold fields. Many miners and mining interests did not immediately switch over to steam or air drills (ILLUS. 19), however, their introduction did have implications for mining operations (ILLUS. 20), particularly in the area of shaft sinking.

A. A. Hayward discussed how he had employed two Rand No. 2 rock drills to sink a shaft through hard rock at Waverley. The shaft was divided into two compartments, each measuring 4 feet by 4 feet inside dimensions and requiring rock dimensions of 5 1/2 feet by 12 feet. To expedite the work, the labour force was divided into three shifts of eight hours each:

> The first, and drilling shift began at 7 a.m. and consisted of a foreman, two drillers and two helpers. The men in this shift were expected to drill all necessary holes, and to have the work completed before three o'clock; the drills, tools and piping were then hoisted to the surface leaving the shaft ready for blasting. The second shift, which began at three o'clock consisted of two muckers and a firing boss, whose duty it was to measure the depth of each and every hole, keep a record of the same, also keep a record of the amount of explosives used in each and every hole. The firing boss remained on shift sixteen hours, and had charge of both the second and third shifts ... This shift was expected to fire the four sump holes and to clean up the same during the eight hours.
> The third and last shift, which consisted of but two muckers, were expected to fire all the remaining holes, clean up the rock, quarry any loose rock in the bottom of the shaft, put in any new slides and do any necessary timbering, and leave the shaft ready for the drilling shift.[1]

In addition, there was a surface crew which was divided into two twelve-hour shifts. The first included an engineer, deck man, blacksmith and carpenter, while the second there was only the deckman and an engineer. Using this system of drilling and blasting, plus shifts of timbermen when the shaft reached additional depths of fifty feet to construct the necessary stagings and stalls, the shaft progressed on the average of three feet per day. Hayward calculated that using this system a shaft measuring 4x12x200 feet would cost $20 per foot to sink, and it would take approximately one month to progress 40 feet, substantially cheaper and faster than if done by hand.[2]

During the late 1890s until the early part of 1900, the common procedure had been to sink a number of mining shafts on the same vein, each successive one being deeper or shallower than its predecessor depending on the pitch of the ore-body. Then levels were driven off, on the vein, at varying distances of 50, 100, or 150 feet apart and the vein was stoped out.[3] An examination of photographs of Goldenville companies, (c.1897, demonstrates the impact of this procedure) on the surrounding landscape. Close to one another, crude shaft houses were erected over the shaft and a series of tramways were constructed linking the shafts with one another and with the mill house. The shaft structures were wood framed with ladder-access and ore chutes protruding over the tramway to transfer the ore from the shaft to the mill. ILLUS. 21,22, and 23.

The way in which the landscape was transformed by Faribault's system of deep mining[4] is revealed in the photograph of the Royal Oak's 450-foot shaft house, ILLUS. 24, as well as in the later photographs of Goldenville's mining concerns. ILLUS. 25 & 26. Shaft houses were not required in the single shaft system and the development of more extensive underground workings. ILLUS. 27 & 28, underground plans of Dufferin Mines and Salmon River and ILLUS. 29, underground workings using the multiple shaft and the single vertical shaft systems.

A second mining system to have an impact upon the landscape was open pit mining. This method had been used in the earlier period, but not to the same extent as during the later years. George Stuart used open pit mining on the Mayflower Belt in Goldenville during the 1890s.[4] ILLUS. 30 & 31

The method of stoping was undergoing change during this later period. Since the 1860s, the method most commonly used was that of underhand stoping.[5] Wallace MacDonald (b. 1905) recalled that in his father's time at the Goldenville mines, the underhand method was employed: "It was different then. It was all underhand work they done then (pre W. W. I.)"[6] Underhand was used at the Blue Nose, while at the Royal Oak both methods were tried.[7] More mines switched to the overhand methods as the use of cross cutting and the single vertical shaft increased. The further refinement of heavy drills and support systems would make the overhand method more feasible than it previously had been.

In 1900 the Blue Nose made a series of cross cuts from the main shaft and intersected a number of veins that had been exposed before.

> The Springfield belt was worked throughout a length of 900 feet and to a depth of 400 feet. It was believed that by cross cutting towards the anticlinal axis other auriferous veins might be found. Three cross cuts were, therefore, driven north from the Springfield belt at depths of 280, 364 and 460 feet and were carried respectively to lengths of 230, 250 feet. Several belts not exposed on the surface were cut.[8] ILLUS. 32

Another development in the later mines was the use of ore chutes in removing ore from stopes.[9] As we see in ILLUS. 33 the ore is coming down the chute from the above stope. The ore-car would then be pushed to the main shaft and loaded into the cage to be taken to the surface for sorting, as shown in ILLUS. 34. The ore chutes were usually constructed from 15 to 30 feet apart.[10]

Not all mines were as well equipped as the Baltimore and Nova Scotia in Caribou. In the 1903 Department of Mines Report it was reported that the Blue Nose Gold Mining Company had sunk a shaft measuring 14 1/2 x 4 1/2 feet on the Palmerston Belt. The shaft was divided into three compartments: a skip way, a tub-way for sinking and baling, and a ladder and pump compartment. The skip system appears to have been a common means of hoisting ore from the mine to the shaft as well as to the mill.[11]

There were still the smaller operations scattered throughout the province that made use of older hoisting systems, the whip and the windlass, dependent upon horsepower or manpower. However, such devices were more commonly used in prospecting shafts or during the early stages of shaft sinking. ILLUS. 19, 35 & 36.

The use of steam to hoist ore tubs even in the most primitive shafts is evident in ILLUS. 37. In other operations the common wheelbarrow would be utilized to haul ore from the mine. ILLUS. 38

In the larger concerns hoisting was done both by steam and air.[12] In the mining and industrial journals, published throughout the 1890s in Nova Scotia and Canada, there are numerous advertisements for hoisting machines. Suppliers included the Lidgerwood Manufacturing Company in New York; the Quebec company, Jenckes Manufacturing, with an office in Halifax; and local foundries such as The Truro Foundry, Matheson's, in New Glasgow and Fraser Brothers, also in New Glasgow.[13] In April 1900, Thomas Cantley, president of the Blue Nose Mining Company, sent inquiries to Carlin Machinery and Supply Company, Allegheny, Pennsylvania, about a hoisting engine. ILLUS. 39. He specified a "Lidgerwood single or double drum with reversing action and a brake lowering device".[14] In the 1899 edition of the Canadian Mining Manual the hoisting engine at the Blue Nose had been identified as manufactured by Fraser Brothers, New Glasgow; a 1903 report states that there are three Jenckes hoisting engines in the plant system.[14] The magnitude of one hoisting engine at this company is evident in ILLUS. 40. See also ILLUS. 41 and 42.

5.2.2 Drilling and Blasting

Throughout the 1890s hand work continued in many Nova Scotian gold mines; often there was a reluctance to move to the air rock drills:

> There was for some time a prejudice against the adoption of machine drills, some claiming that owing to the ease with which the slate is worked it was as economical to drill by hand. But records of the cost of the two methods have shown the economy of the machine drill. From May 1, 1897, it cost with hand drilling on an average $2.54 per ton to deliver ore to the mill from the Libbey fissure, Brookfield, a vein not averaging over 14 inches in width of crushing material; while in January, February, March 1898, the average cost with machine drills $2.44 per ton, This shows a balance of 10 cents per ton in favour of the machine drills. Besides with the air plant they were able to do in a given time 25 per cent more sinking and drifting than with hand drilling.[15]
> Illus. 43.

Machine drills were in use in Goldenville between 1895 and 1900. Neil McEachran, a Goldenville miner, expressed approval of their employment in an interview with The Industrial Advocate:

> Just look at the New Glasgow Company, they are working old pits which have been abandoned for years. They never paid when they were last worked, and now, with dynamite and air drills, in place of black powder they pay very fairly.[16]

Two types of air drills were used in the underground work: the piston drill for sinking and driving, and hammer drills for stoping.[17] Ingersoll-Sergeant, Sullivan and Rand drills were all employed at various times within Goldenville operations. In 1899 the Blue Nose was using Ingersoll-Sergeant drills; a Norwalk compressor was to be added that year to operate a total of ten air drills. In the 1901 Mines Report there are recorded four Rand and one Sullivan drill; by 1903 the Rand drills appear to have been replaced by Sullivan drills operating from a Norwalk straight-line air compressor.[18] ILLUS. 44.

These early air drills were known as dry hammer drills. It was not until this century that water was added to reduce the dust levels in the mines.[19] ILLUS. 45 shows the drill used to cross-cut in the New Egerton Gold Mining Company at Fifteen Mile Stream, 1897. The drill would be set in place at the rock face and cranked into position to drill the blasting holes. Note in this photograph that the main source of lighting for the drillmen to work with was provided by candle-power. Candle-light continued to be the main source of illumination in the drifts and stopes in Goldenville during the first decade of this century.[20] ILLUS. 45 & 46.

Wallace MacDonald described what it was like when he was drillman in Goldenville throughout the '20s and '30s, after water drills had been introduced:

> Workin' on the drill was an awful dirty job. Greasy and wet. Noisy. You couldn't hear a sound after you came out. Oh, you was all grease from the drill... You had a lubricator that fed oil to the drill all the time... and the compressed air blowin' it out and it would be all over. Over your face and everything. You'd be as black as can be.[21]

There was a division of labour underground just as there was in the shaft sinking process. The drillmen and his helpers worked the first nine hour shift; followed on the next shift by the muckers who were responsible for removing all the ore from the drift or stope:

> One shift, the drillman, would all go in at the same time and they'd all be drillin'. Then, at the end [of the shift] they'd blast.

> And the mines would be empty generally from 5 p.m. to 7 p.m. It had two hours to blow out the gas and dust, to clear the air. Then the night shift came on at 7 and started muckin'. They'd be lucky to get through in nine hours.[22]

The number of holes drilled depended on whether they were in a drift or a stope. In a drift 'you'd generally drill about 17 [holes]", while in a stope, you'd generally put in about 12."[23]

MacDonald estimated that in his time the holes measured 6 1/2 feet deep while in his father's time (c. 1890s - 1920), they were using 6 feet steels, making the holes approximately 5 1/2 feet in depth.

> The place (the stope) would probably be five feet wide and you'd drill one row ... three holes across. And then, you'd be up where you'd drill three more holes. You done that right up as far as the face went.[24]

Once the holes had been drilled, they were tamped:

> You had to tamp the holes before blastin' them. You'd take a piece of paper and wrap it around a stick; fold it over on the end..., we'd call them loading sticks. Generally we'd put the loadin' stick in in the hole to see that it was clear (after the hole had been dried out with the blow pipe) and then you'd put your dynamite in.[25]

The loading sticks were used again and again, until they had worn down to such a point that they were no longer useful.

> You just had one (loading stick). Generally they'd be seven or eight feet long. And they'd wear down on the end until they got sharp. You'd cut them off, and they'd get shorter and shorter, until you'd have to get another.[26]

Once the dynamite was in and tamped, there was a definite manner in which each charge was lit to go off.

> ... according to if you were drillin' in a drift or a stope, there was certain holes that had to go off first and other holes that had to follow. If you had three holes in a row ... this one (the centre one) had

> to go first before the others... the centre would have to break down before the others would break out. ... it would blast that piece out of the middle and then these holes blast into that. And then when you come up onto the next row of holes you done the same thing. The centre one went, then these two.[27]

Once the dynamite was loaded into the holes in the face, the fuses had to be lit:

> ... we'd use to light [them] with a lamp ... we had carbide lamps at that time [post W.W.I.] and we'd just light them with the flame of the carbide lamp. You see, you split your fuse at the end so to have some loose powder... you'd split it by cuttin' the middle of it and then light it. And according to if you were drillin' in a drift or in a stope there were certain holes that had to go first and other holes that had to follow. Well, your fuses would all be the same length, say seven foot, and for the first hole (the one that had to go first) you'd cut so much off to make your fuse shorter. You'd keep doing that so the longest fuse would be in the last hole. Lots of times we'd make what you'd call a 'spitter'. We'd cut the fuses every inch or, right into the powder, and then turn the ends out. Then as it burned, every time the light came to one of those places that was turned out, it would spit ... spit fire right out. You'd use that for lightin' the other holes.[28]

All the blasting in the mine would be done during the same time near the end of the shift.

The drillmen were responsible for blasting their own charges and insuring that they went off:

> ... they counted the holes - you always counted the holes when you blasted to see that they went. You knew how many [charges] you had in and you'd listen to see how many went off.[29]

Since all the blasting would be done at the same time, more or less, a sequence was developed to enable each man to listen to his charges:

> If there was somebody out further than you were, he would wait until your holes went. Then he'd light his and they'd go. And if there was somebody out further, then he'd light his...[30]

Once the blasting was complete, the men would leave the mine and preparations were made for the next shift. Following the blasting, the mine would be filled with smoke and gas. Once air drills had been introduced, it was a fairly simple matter of blowing air into the underground areas. Ventilation was provided by the old shafts and winzes.[31]

The next shift that came in, once the mine was clear, were the muckers. It was their responsibility to clean out the ore from the area that had been blasted and get the face cleaned up and ready for the next shift of drillmen and their helpers. ILLUS. 33 . The man working at the ore chute would be classified as a mucker.

When the underground work was predominantly underhand stoping, all the work was done by hand:

> ... it was all done by hand. All shovel work...
> they loaded right into skips. They didn't use
> no trolley cars at all...[32]

As the mining operations became more systematic there was an attempt to reduce the amount of handling ore by hand. People were aware of the minute proportions of gold to large amounts of low grade ore. The installation of ore chutes ILLUS. 32, the use of tramcars to truck the ore from the level to the shaft, and skips or tram systems to transport it to the mill were all means of achieving this end.[33] However, it was only in the large operations that such systems could be installed. The installation of mechanical devices above and below ground to reduce hand labour demanded a high level of production to keep the 'modern' plant in operation at a profitable level.[34] So, in many of the smaller operations wheelbarrows continued to be used to haul the ore from the drift or stope to the shaft.

END NOTES

5.2 Underground Development

1. A. A. Hayward, "Rapid Sinking in a Nova Scotia Gold Mine" in The Measures of Nova Scotia and Deep Mining Together with Other Papers Bearing upon Nova Scotia Gold Mines. (Transactions of the Mining Society of Nova Scotia v.IV, 1899), p. 33 - 34.

2. Ibid. p. 34.

3. W. Malcolm, op. cit., p. 111; N. S. Department of Mines, OFR 171 (unpublished report, 1911) p. 7.

4. GSC, Summary Report, 1891, W. Malcolm, op. cit.

5. Malcolm, op. cit., p. 112.

6. W. MacDonald, Interview, Tape 2, Side A.

7. N. S. RDM, 1902.

8. W. Malcolm, op. cit., p. 235.

9. N. S. Department of Mines, OFR, op. cit., p. 7.

10. Ibid. p. 7; W. MacDonald, Ibid.

11. N. S. RDM, 1901 & 1903, p. 50; C. F. Andrews, "Notes on Gold Mining of Low Grade Ores in Nova Scotia", Journal of Canadian Mining Institute, v.2, 1894, p. 6., illustration of skip system employed at Country Harbour. PAC RG 45, v. 146. Faribault's Notebook 4451, Sept. 13, 1899, p. 35, description of operations at Dufferin Mine, Salmon River.

12. H. C. Scott, op. cit., p. 7. According to this report, hoisting in most N. S. mines was accomplished by "horse whims and hand windlasses". However, beyond the 150-foot level this type of power was inadequate.

13. B. T. A. Bell, ed., op. cit., Industrial Advocate, v.II, n.7, May 1898, p. 3; also, v.1, n.6, April 1897, p. 2.

14. PANS, MG 1, Thomas Cantley papers, correspondence, 24 April 1900; B. T. A. Bell, ed., op. cit., 1899; Nova Scotia Mining Number (Halifax), 1903.

15. W. Malcolm, op. cit., p. 112; J. C. Murray, op. cit., p. 2;

G. Stuart, "History and Outlook", op. cit., p. 33. According to Murray, hand drilling was common until the 1890s when the price of labour was sufficiently low to complete with the efficiency of machinery.

16. Industrial Advocate, v.1, n.5, May 1897, p. 17.

17. N. S. Department of Mines, OFR 171, op. cit., p. 8.

18. B. T. A. Bell, ed., op. cit., 1899; N. S. RDM, 1900.
Rand steam drills were used at Royal Oak; Rand and Sullivan at the Blue Nose; N. S. RDM, 1901, Rand drills were replaced by drills of the Sullivan pattern at the Blue Nose. In 1903, there were five Sullivan drills in use.

19. Wallace MacDonald, Interview, Tape 1.

20. Dalhousie Archives, Killam Library, Raddall Papers. Byrne material on goldmining: both candle light and seal oil lamps were used in the gold mines of Queen's County. Also illustration 18: R. G. Fraser, Halifax Chemist advertised the sale of miners' oil lamps in Belcher's Almanac, 1865.

21. W. MacDonald, Interview, Tape 1, Side A.

22. Ibid. Tape 1, Side A.

23. Ibid. Tape 1, Side A.

24. Ibid. Tape 1, Side A.

25. Ibid. Tape 1, Side B.

26. Ibid. Tape 1, Side B.

27. Ibid. Tape 1, Side B.

28. Ibid. Tape 1, Side A.

29. Ibid. Tape 1, Side B.

30. Ibid. Tape 1, Side A.

31. Ibid. Tape 1, Side A; See also W. Malcolm, op. cit., p. 111 and p. 123, figure 1, showing ventilation system at the Libbey Mine, North Brookfield.

32. Wallace MacDonald, Interview, Tape 2, Side A.

33. A. Woodhouse, "The Occurence and Reduction of Gold" in Journal of the Mining Society on Nova Scotia, v. II, 1893 - 94, p. 21.

34. J. C. Murray, op. cit., p. 3; Andrews, op. cit., p. 7.

5.3 Surface Buildings

5.3.1 The Shaft House

As discussed earlier in 5.2.1, shaft house structures varied from operation to operation; size and design depended upon the type of mining used. ILLUS. 21, 24, ILLUS. 47 & 48.

The function of the shaft house in every operation was to protect the shaft from the elements of nature. However, some buildings also were used to house machinery and/or to store ore. Consequently the contents of the shaft house and their arrangement varied from mine to mine. For example, the main shaft of the Blue Nose in Goldenville contained "a 40 ton ore bin and a large-size Gates rockbreaker"[1]. A similar arrangement was described by E.R. Faribault at the Dufferin Mine at Salmon River. Here the ore was brought up from the mine in "sheet-iron wagonettes" in two cages that were counterbalanced. At the surface the ore was dumped from the wagonette onto plates of iron and, with the exception of the largest pieces of slate, the ore was chuted down into an immense 12 x 20 inch Mason-Blake breaker.[2]

One of the more thorough descriptions of the shaft house gear is that of the Boston and Richardson Gold Company at Goldboro in the 1907-'08 Report of the Mining and Metalurgical Industries of Canada:

> Shaft House: 32 x 46 feet, with change room annex 12 x 33 feet; pump house annex 18 x 24 feet, containing 90 h.p. internal fired boiler, steel jackets; 2 Blake jaw crushers, one 60 h.p. straight line engine for operating crushers, Cornish pump, etc; one Cornish pump; one Gates rock breaker; style k. no. 5; one trommell 1 1/4 inch; one 36 foot bucket elevator.[3]

At the Brookfield Mining Company in North Brookfield, Queen's County, the mill building was located directly over the shaft house. The ore was hoisted from the shaft to a deck on the top of the mill. The deck was faced with iron plates, and the ore was dumped directly onto the floor from where it was shovelled directly into a 10 x 15 inch Dodge rock breaker placed below the level of the deck. From that level the crushed ore was fed directly into various ore bins. The hoisting engines, a double cylinder steam engine, was placed on the ground floor of the mill.[4]

The most basic shaft house required for the opening up of a mine was described in this maner:

> ... a shaft house should be built, say 40 feet x 60 feet, with ore house for storage of ore, say, 40 feet x 40 feet; the equipment should be a 40 h.p. engine and a 60 h.p. boiler. The machinery, shaft house and skip, with which all incline shafts should be equipped, will cost about $4,500...[5]

The placement of the rock breaker varied from mine to mine. The crusher at Hardman's mill at Oldham was situated on the top floor of the mill building similar to that in ILLUS. 49. There were difficulties with this arrangement, primarily because the weight of most crushers added additional strain to the mill building.[6] Other mine managers recommended that the crusher be placed in the shaft house, and the ore be sorted and crushed before being transported to the mill. Another factor favouring this arrangement was that it reduced dust levels in the mill.

5.3.2 Other Surface Structures

i) The Hoist House

In addition to a shaft house, some mining plants had a hoist structure to house the gear employed for hoisting the ore from the mine. The hoist house at the Boston Richardson Plant in Goldboro was a frame building, 18 x 24 feet, "containing one Jeneckes double drum hoist, 2 cylinders, each 10" x 12", operating skip cage, safety clutch, 7/8" cable.[7]

At the Dolliver Mine the "large double drum Lidgerwood electric hoist" (ILLUS. 42) was housed in an engine house, 60 feet x 45 feet, situated close to the shaft house. In addition to the hoisting engine, the engine house contained the air compressor for the underground drills.[8]

The Blue Nose did not have a separate hoist house for its hoist and engine system. It was also located within "a commodious shaft-house".[9] The illustrations of the Royal Oak Mine in its 1902 Prospectus do not show a separate structure to house the hoisting and related gear. ILLUS. 50

END NOTES

5.3 Surface Buildings

1. N. S. RDM, 1901, p. 49.

2. PAC RG 45, v.146, Notebook 4451 (1899) Sept. 13, 1899. Faribault's description of Dufferin Mine at Salmon River.

3. Canada, Report of the Mining and Metallurgical Industries of Canada, 1907 - 08 (Ottawa, 1908.), p. 512.

4. B. T. A. Bell, ed., op. cit., 1899.

5. S. A. Joseph, "How to Open Up a Mine", Industrial Advocate, v. V, n.5, March 1900, p. 12. This shaft house was recommended for a 500-foot shaft and a system of drifts, along the full length of the 1,500 foot claim.

6. J. E. Hardman, "Recent Gold Milling Practices in Nova Scotia", Transactions of the Mining Society of Nova Scotia, v.I, part II, p. 35.

7. Canada, Report of the Mining and Metallurgical Industries of Canada, 1907 - '08, p. 513.

8. N. S. RDM, 1902, p. 49.

9. N. S. RDM, 1903, p. 50 - 51.

5.4 The Stamp Mill

5.4.1 The Building

The mill building was designed and built for function rather than style. Important considerations in establishing and constructing the mill were selection of the site, cost of labour, security precautions, and lighting possibilities.

During the entire period of gold mining in 19th-century Nova Scotia, water power was not exploited to the extent it could have been. Although water may have been available as a power source most stamp mills used steam.[1] In Goldenville, mills were built on the main brook of the North West Arm, or what Faribault called "Crusher Brook", as well as close to the actual diggings.[2] In selecting the site, water had to be available to facilitate the stamp mill operation, but not as a source of power. The presence of rock for the stamp mill mortar foundations was of utmost importance. Since the mills were operated on a gravity feed system, there was an attempt to use the landscape to that advantage.[3] However, in an area like Goldenville, where the topography did not lend itself to such use, the design of the building would have to compensate.

> ... it is always advisable, when possible, to choose the side of a hill having a fairly rapid slope, and consisting of rock sufficiently solid to form a good foundation for the battery. The average height of a mill of the "high" type, with a rock-breaker floor above ore bins of normal capacity, may be taken as 50 to 55 feet from the level of the car track to that of the concentrator floor, the length over all of the profile of the mill being rather over a 100 feet. Hence, a slope of 1 in two is most suitable for a mill site.[4]

As discussed in section 3.2 mills built during the 1860 period were not always located close to the mine shaft (s). Labour was relatively cheap, so it was simple to haul the ore with horse and cart or in wheelbarrows.[5] During this later period, there was a general attempt to reduce the amount of handling of the ore both above and below ground. The site of the mill was considered with this factor in mind. The mills were located close by and usually connected by means of a tramway system.[6] ILLUS. 21, 22, & 23.

Throughout the gold mining districts of the province, and virtually wherever they existed, there was a perpetual concern about security. Miners were forever suspected of pilfering nuggets.[7] There was considerable precaution exercised in the appointment of millmen:

> In conversation with Mr. W. L. Libbey, he told me that Howard Martin and Rufus Mosher were good amalgamators, and if you wish me to engage one for you I will do it. Mr. Libbey thinks that Mr. Mosher would be the man for you. I certainly think it is a good idea for you to have a man from North Brookfield with you, particularly one who you know is perfectly honest, and one who would look after affairs so there would be no danger of the amalgam being stolen.[8]

This same type of concern would be reflected in the design of most mills:

> A mill should always be enclosed in a substantial building, admission to which should only be obtained at one or two points.[9]

Similar concern was expressed about the ability of the building to withstand the elements and also, potential fire damage:

> In America, these structures are mostly of all wood but this material, though possessing some advantages, presents great risk on account of fire... The system prevalent in America of building all the roof in one plane is also not to be recommended, as such a roof is liable to damage from storms. It is better built in three or four bays, which moreover give excellent opportunities for lighting and ventilation.[10]

The problem of adequate light and working space was also an important matter in mills of the later period.[11] Prior to the turn of the century, most Nova Scotian mills were lit by natural light and kerosene lamps. ILLUS. 51. Some mills, such as the Lake Lode Gold Mine mill at Caribou were designed to take advantage of whatever natural light there may be during the day. This mill had a system of skylights installed to provide light to two levels within the building. ILLUS. 52. The use of windows to provide additional light is evident in the Royal Oak Mill and the Harrigan Gold Mine Mill. ILLUS. 50, 53-55.

Mill structures would be at least three stories in height, to accomodate all the necessary mill equipment as well as to use a gravity-feed system. ILLUS. 49,52,55. The Blue Nose Mill appears to have been a three and one half-storey building; the Royal Oak was a substantial four-storey building.

The mill flooring was usually a substantial material that did not allow the leakage of either water or cement. It would appear from ILLUS. 51, and ILLUS. 52 that plank flooring was installed. In his 1897 edition of A Handbook on Stamp Milling, Henry Louis recommended "a good cement floor, or failing this, a floor of stout 3-inch plank having the joints carefully caulked like the deck of a ship."[12]

Hardman's Oldham Mill floor was "laid in hard pine with a pitch of half an inch to the foot, and a sluice was arranged to carry all washings from this floor to a mercury trap below."[13]

5.4.2 Arrangement of Milling Gear

The arrangement of milling equipment with a mill followed Louis' rule of thumb, that the ore was not to be lifted once it had entered into a mill building. An examination of the Oldham Mill Plan, 1891, and Louis' prototype mill plan demonstrated how the mill equipment was arranged for efficient mill operations using a minimal amount of hoisting power.[14] ILLUS. 49, 57, & 58.

The ore was hoisted to the top of the mill building either by tramway or skip. If the crusher was not located in the shaft building or in its own separate structure, it would be found at the top level of the mill building. From the crusher, the ore fell into ore bins which were located directly below the crusher. From the ore bin, the ore was fed either automatically or by hand into the stamp battery. Following pulverization and amalgamation within the stamp battery, the tailings flowed out of the battery and along the system of amalgamating tables. If the mill had any concentrating equipment, frue vanners or wilfley tables, they were located on the next level, below the amalgamating tables.

The power source, the engine, and the boilers were usually located on the ground floor of the mill. In the North Brookfield Mill, the plant engine and two 60h.p. boilers were installed.[15] The engines and boilers were generally not placed close to the stamp battery, because of the problem of dirt and grease in the mill operations. ILLUS. 23, 50, 54, 55, & 59. Both the Royal Oak and the Blue Nose appear to have had a power house annexed to the mill building. The Blue Nose equipment included two boilers of 80 h.p. and a 100h.p. to supply the engines of 40 and 30 h.p. respectively which provided motive power for the mill, pumps, hoist and rock breaker.[16] An examination of the terrain surrounding the Blue Nose and the Royal Oak shows that the boilers and engines were installed on a floor faced with fire bricks.

5.4.3 The Stamp Mill

Following is a look at some of the pieces of equipment within the mill, as well as the different parts of the stamp mill itself.

i) The Rock Crusher

Rock crushers had become fairly common within larger operations by the end of the 19th century. Independent miners may have continued to rely on sledge-hammers to crush the quartz ore, but larger groups preferred the efficiency of the crusher. Some operations moved to a system using two crushers to increase the amalgamating potential of the stamp mill.[17]

The rock crushers weighed from two to twelve tons and the amount of power required for operation varied directly to the weight.[18] Hardman's mill used a "Forster rock breaker" in lieu of either the "old Blake" or the newer "Gates". The choice made was based on the following reasons:

1) for machines of equal capacity the Forster requires very much less power than either of the others, taking less than one-half the power required by a Gates;
2) the total weight of the Forster machine, of equal capacity, is only one half that of the Gates and considerably less than that of the Blake;
3) the vibratory motion induced by the machine is very much less...
4) the cost of the Forster is less...[19]

Hardman argued that weight and amount of vibratory motion were of equal importance to the questions of power and cost for a small mill.

The Blue Nose used all three types of crushers in its operations between 1896 and 1904: A Dodge Breaker was added in 1898; a Forster breaker was in use according to the report, and 1901 and 1903 reports refer to 1 Gates ore breaker. A 7' x 9' Dodge ore breaker was installed in the Royal Oak plant circa 1899-1900.[20] ILLUS. 60.

In the larger, more modern plants a grizzly was often added to the rock breaker to increase its efficiency. The grizzly was essentially "an inclined plane or iron bars leading down to the mouth of the rock-breaker, the bars set at a distance apart equal to the space between the bottom ends of the rock-breaker".[21] The function of the grizzly was to sort the chunks of ore so that the small pieces would bypass the crusher and be fed directly into the battery orebin. The usual arrangement was for the ore to be dumped from the tram car or onto thr rock-breaker floor set level with the top of the mouth of the machine and covered with iron plates. The man in charge of the breaker was equipped with "a stout iron hook or scraper to enable him to drag the ore into the month of the steel shovel for the small stuff".[22]

ii) The Ore Bins

From the rock-crusher the crushed ore was fed into the ore bins located directly below. A general rule for the capacity of the bins was that they should hold at least a 24-hour supply to guarantee continuous mill operation.[23] The ore bins in the Blue Nose in 1901 had a 125-ton capacity.[24]

iii) Automatic Feeders

To improve the efficiency of the stamp mill, each battery was often fitted with an automatic feeder which maintained a regular flow of crushed quartz into the mill. The 60 stamp mill at Salmon River had 12 "Challenge Ore Feeders" that were manufactured by Fraser and Chalmers in Chicago.[25] The Blue Nose Mill had 6 Hammand ore-feeders to regulate ore to each battery of its 30 stamp mill.[26] ILLUS. 61 & 62.

iv) The Stamp Mill

Mortar Box Foundations:

The stamp mills of the 1890s were designed so that the stamp mill was independent of the mill buildings:

> In designing the structure, care was given to make each component of the mill independent, i.e. the building, the battery frames, and ore bins are each entirely separate from the others, so that the building is simply a cover with no strains upon it other than those due to the wind and weather.[27]

Traditionally the foundation of the mortar boxes of the stamp mill had consisted of heavy timbers set upon bedrock:

> The mortar blocks are built of selected two-inch spruce plank, twelve inches and six inches wide, planed on both sides and joined on both edges. The blocks are built thirty inches wide, and are therefore made up of two twelve inch planks and one six inch in each layer; joints in one layer are broken in the next, and each layer is spiked

> to the previous one with 40 dy. nails (five inches long), so that each nail holds in three layers. Each plank is fitted on the bottom to the surface of the bedrock, as it was found impracticable to dress off the whin rock to a smooth and level surface, and concrete is valueless unless put down in a large mass.[28]

Eventually the wooden timber foundations were supplemented and then replaced by concrete:

> The mortar block was built of concrete set on bedrock. The rock used was a hard, fine quartzite, locally known as "whin", ... The quartzite broke in sharp angular fragments and was a most excellent product for concrete. At the bottom the proportions were -
>
> | | |
> |---|---|
> | Broken stone (2"-0) | 5 1/4 parts |
> | Sharp sea sand | 1 3/4 parts |
> | Portland cement | 1 part |
>
> The proportion of cement was increased toward the top. The top was composed of -
>
> | | |
> |---|---|
> | Broken stone (3/8" - 1/8") | 1 part |
> | Sharp sand | 1/2 part |
> | Portland cement | 1 part[29] |

Millmen who had worked with the wood foundations preferred them to concrete because of their resilience.[30] So, in mills with concrete foundations there was an attempt to provide that quality by adding an additional layer of wood, as well as a sheet of rubber or blanketing.

> On top of the concrete block was placed a piece of five inch unbled hard pine thoroughly covered with tar. In regular modern installations it seems a general practice to place a piece of 1/4 inch pure rubber between the concrete and the anvil block [mortar block].[31]

Not only was it desirable to have a resilience of a mortar foundation, it was necessary to have a stable foundation as well. To fully exploit the strength of the bedrock, the following practice was recommended at the end of the 1890s:

> Too much care and attention cannot possibly be bestowed upon the foundations of the mortar block.

> It is set in a trench especially excavated for it, which should always be carried down into the solid rock, all decomposed or broken up parts of the rock being cut away and the bottom of the trench being then made as level as possible. If the sides of the trench are not wholly in hard rock they should be protected by massive retaining walls, built of stone or brick laid in cement or else concrete. At least 6 inches of good concrete should next be rammed into the bottom of the trench, being levelled off as carefully as possible... Upon this foundation the mortar blocks are then set, great care being bestowed upon their alignment and their levelling. The space between them and the sides of the trench should then be rammed with concrete, or else, as is sometimes done in America, some barren quartz may be crushed in the mill and the tailings allowed to run into and fill the trench. These tailings will pack in quite solid, aided no doubt in their settling down tight by the vibration of the mortar blocks in the partly filled trench; in either case the packing should be as tight as possible.[32]

Once the foundations for the mortar blocks were complete, the next phase of construction was the mill framing.[33]

v) The Battery Frames

There were two systems of battery frames in use - the 'A' frame and the 'knee frame'. E. Gilpin's 1882 article about stamp mills in Nova Scotia was illustrated by an 'A' frame mill, which was suitable for light mills with stamps of up to 750 lb.[34] However, with the development of the heavier mills, the knee frmae, developed in Grass Valley, was preferred.[35] ILLUS. 63 & 64.

> Its essential point is the removal of the line shaft from its usual position behind the mortar and beneath the feeder floor to the front of the batteries and on a level with the cam shaft.

Hardman preferred the knee frame construction for the following reasons:

1) The shaft is always in sight, it has the best light in the mill, and is easy to align when necessary;

2) it is removed from beneath the feeder floor, where it is in darkness, and subject to dampness, drip and fine dirt which will inevitably work down upon it and its bearings;

3) any repairs to the shaft when below the feeder floor have to be made by artificial light, and in confined spaces which are usually abounding in grit and fine dirt;

4) it enables the cam shaft belt to be run horizontally, or nearly so, without a tightner, and thereby saves a great deal of wear on the belt.[36]

A further variation on the knee frame was the back-knee or reverse-knee pattern in which the battery posts were bolted to the ore bin timbers. The advantage of this pattern was that it gave an uninterrupted view over the entire mill floor and presented no obstacle to mill men working on either side. However, this style could not be employed unless there were automatic feeders in place since it obstructed easy access to the back of the mortars to provide crushed quartz manually.[37]

The ten-stamp mill frame could be constructed using a plan of three or four posts.[38] The two batteries of the Dufferin mines ILLUS. 51 (following p. 76, this report) appear to have been arranged using the three post system, as does the Royal Oak Mill ten-stamp mill. ILLUS. 50. In the three-post system the bull wheel was located at either side of the battery, while in the four-post it was situated between the centre posts. ILLUS. 65 & 66.

vi) <u>The Mortar Boxes</u>

Some of the foundries that had produced stamp mills during the 1860 period continued to cast mortar boxes, stamps, dies, cams, and lifters in this later period - the Truro Foundry,[39] I. Matheson,[40] and the Windsor Foundry.[41] ILLUS. 67 & 68 . An addition to the list would be Fraser Brothers in New Glasgow which began production in 1883.[42] (ILLUS. 69). Mills were bought as well in the United States, as were other pieces of milling equipment.

However, the Nova Scotian mill had gained a place in Canadian industrial history. In an 1899 letter to Edwin Gilpin about an upcoming exhibit of Nova Scotian gold specimens, George Dawson, CGS, argued against a separate display of Canadian mining machinery because:

> nearly everything made here is made on foreign pattern and by branch establishments. There may be one or two exceptions - ... and it occurs to me that one such case might be the stamp mills made at Truro which appear to have gained such an excellent reputation.[43]

The mortar boxes for stamp mills were made of cast iron and were cast in one piece. The weight of the boxes was proportioned to that of the stamps:[44]

Number of Stamps in Each Mortar	Weight of Stamp lbs.	Weight of Mortars tons	cwt.
5	1250	4	0
"	1050	3	5
"	950	2	17
"	900	2	10
"	850	2	5
"	750	2	0
"	700	1	16

The five-stamp battery mortar box measured between 45 inches and 60 inches long, 18 inches to 24 inches wide at the base, and 39 inches to 56 inches high. At the back of the box there is an opening to facilitate the feeding of the quartz either by hand or automatic feeders.[45]

There were modifications in the mortar box according to whether the stamp mill would be a custom mill, crushing and amalgamating quartz from a number of different operations, or a company mill. Hardman's mill was a custom mill and he had made the following changes to the mortar box:

> The mortar are modified from the Homestake pattern only in the fronts which are cut down to within two inches of the bottom, the height of the front being regulated by wooden chuck blocks faced with thin steel plates. Also the lip has been extended three and a half inches.
>
> The essential character of the mortar is not at all affected by these modifications which have been made only for minor points of convenience. The cutting down of the iron was done for two reasons: ... it was desirable that the whole mortar should be readily accessible for a thorough clean-up; and secondly, because of the very diverse character of the quartz coming to a custom mill, necessitating perhaps a high discharge for one lot and a low discharge for another.[46]

Another factor affecting the design of the mortar box was whether inside copper plates were used to maximize the amalgamation process. In Gilpin's 1882 article about stamp mills, he remarked that only a few Nova Scotian mills had made use of inside plates.[47] Hardman's Oldham mill employed just one inside plate, at the front of the battery:

> The first plate lies inches inside the mortar just at the lower edge of the screen, and about ten inches above the dies. It is made from a strip of copper one-eighth of an inch thick and three-quarter inches wide; the length being the full length of the screen; about 48 inches.[48]

Hardman found the inside plate worked quite well; it did not choke or fill with the sands, "the splash form the screen being sufficient to dislodge the sands but not the amalgam".

There appears to have been some controversy about the effectiveness of using inside plates. Through its use, the mill lost efficiency in pulverizing the crushed ore, but gained in the amalgamating process.[49]

xii) Cams

The two-armed cast-iron cam was the pattern adopted in the mills of the '90s. Cams were either right-handed: "one that runs on the right side of the stamp when the observer is looking in the direction in which the upper arm of the cam is revolving, hence the boss or hub of the cam is also on the right hand side", or left-handed: one that runs on the left hand side of the stamp, etc.

Cam shafts were designated as left-handed and right-handed according to which end carried the bull wheel. A right-handed or left-handed cam shaft could have either right or left handed cams.[58]

5.4.4 Amalgamation

The stamp mill was used for two different functions: 1) to thoroughly pulverize the crushed quartz, and 2) to facilitate the amalgamation process. The weight and movement of the stamps sufficiently accomplished the first aim; the height and rate of drop of the stamps, the mesh and angle of the screen and the addition of water and inside amalgam plates assisted amalgamation.

A variety of means had been tried to improve the pulverization process, only to hinder amalgamation:

> High front and fine screens have been used to prevent the gold escaping from the mortar. High fronts and fine screens are conducive to fine grinding, and no doubt liberate a large percentage of gold that would otherwise escape in low fronts and coarse screens. When, however, you increase the height of your fronts and use closer screens, you also increase the difficulty of having a sufficient supply of water reach the crushing surface of the dies to thoroughly wash out the disintegrated particles of pulp after each thrust of the stamp, and also to keep the base below the crushing surfaces of the dies, so essential to the protection of the coarse particles of gold so so common in our ores ... Do we, by raising fronts, and using finer screens and subjecting all the gold values to the pulverization action of the stamp during

> the period of the run before the clean-up is made, lose in float gold (or what I term the wear and tear of gold) an equivalent in values equal to what we liberate by fine grinding?[59]

Water had always played an essential part in the amalgam process, but it was not until the later '90s that it was recommended that the water be introduced into the mortar box below the crushing surface of the dies:

> ... the water usually dropped or directed into the mortar by means of a series of small jets or nozzles at any desired point below the crushing level of the dies would bring about the desired agitating result ...[60]

O'Shaughnessy concluded that the addition of water below the stamp dies would retain a large percentage of the coarse gold within the battery between the stamp dies "in particles still having their sharp angles, and as free from wear as when first liberated from the ore".

i) Inside Amalgamation

Inside amalgamation was carried out by the addition of mercury to the mortar boxes. The quantity of mercury used was about three times the amount of gold thought to be held by the crushed quartz. The mercury globules were broken down by both the stamp action and the wash of the pulp to become thoroughly mixed with the pulp. When the mixture comes in contact with the gold particles, it forms an amalgam. The amalgam either settles down between the dies or is projected through the screen to be caught either on the amalgam tables outside or to adhere to the inside plates, if used.

Few millmen used automatic mercury feeders, preferring to regulate the feed themselves. The mercury was kept in the mill in "closely stoppered bottles of very thick glass". As discussed in section 3.3, a sodium amalgam was sometimes added to the mercury to prevent it from flouring or sickening.[61]

ii) Outside Amalgamation

Outside amalgamation was done by means of copper-plated amalgam tables.[62]

> These consist of a sheet of copper, the upper surface of which has been thoroughly amalgamated, to the copper amalgam so formed, a thin film of mercury will always adhere, and this film of mercury immediately amalgamates any gold that may come in contact with it, the gold amalgam so produced adhering to the surface of the copper plate unless there is a great excess of mercury present... The theory of table-amalgamation, therefore demands a clean surface of copper amalgam, carrying a small excess of mercury with which every particle of the escaping pulp shall be brought into contact.

The arrangement of amalgam tables varied from mill to mill. ILLUS. 51 and 70, 71 and 75. Ideally the tables were independent from the stamp mill, arranged in such a manner that their levels could be easily adjusted. The length of the tables depended upon the nature of the gold:

> If the gold is coarse a short table will suffice, but if fine a proportionately longer one must be used. The length varies accordingly between five and twenty feet. A good average length is fifteen feet, or say five plates three feet long, with a drop of about two inches in depth between each one.[63]

The quantity of water necessary to keep the pulp travelling slowly down the amalgam plate depended on the fineness of the crushing as well as the nature of the gold, coarse or fine. Finely-crushed ore required more water and less grade than coarsely-crushed. Louis recommended that the grade of tables should range between 1/2 inch and two inches to the foot.[64]

Generally, when there was inside amalgamation there was no need to add mercury to the outside plates, although some millmen followed this procedure. For a discussion of arrangement of tables see Del Mar, p. 118 - 123, a copy of which is in the research files at Sherbrooke.

5.4.5 Cleaning Up the Mill

The tools used in cleaning up the amalgam plate included:

- amalgam knives (large-sized painter's palette knives, 6 to 8 inches long, made of flexible steel)
- scrapers
- wood chisels (1 or 2), 1 - 1 1/2 inches wide
- an enamelled plate (sometimes ceramic) to hold the amalgam

ILLUS. 51 (p. 76) and 75 depict men cleaning up the amalgam from the tables. Using scrubbing brushes or "the india-rubbers", the millmen started at the base of the tables and rubbed all the collected amalgam upwards. Any amalgam that adhered too firmly to the table was loosened carefully with the scraper or wooden chisel. Once the amalgam had collected at the top of the table, it was scraped by means of the amalgam knife into the amalgam plate, In ILLUS. 51, the plate is at the feet of the man on the left hand side of the photo. The tables were then rubbed down with a small amount of mercury and the mill was again ready for operation.

This level of clean-up of the plates was a fairly regular procedure. It should have only taken about 10 minutes. It was also a time to re-adjust screens, blocks and to make any necessary small repairs while the stamps were hung up.[65]

To thoroughly clean the amalgam plates a more-involved process was required. It was easier if the plates were heated up. In some mills, they were removed and heated; in others the steam power in the plant was used to heat up the plate "by turning a jet of steam onto it" and then cleaning thoroughly as before.[66]

In addition to cleaning up the tables, the batteries were cleaned weekly, fortnightly or monthly. Following is Louis' description of a thorough clean-up:

> It need hardly be said that a clean-up offers specially favourable opportunities for theft, so that constant vigilance is demanded on the part of the mill-manager,

> who should really never leave the mill from the commencement to the end of the operation. The contents of all the boxes have now been collected and are ready for treatment. Here again, if a large staff is available, the treatment of these may commence as soon as the first mortar-box is emptied out, and may proceed simultaneously with the cleaning out of the remaining boxes. There are various ways of treating these sands, each of which has its advocates. In a small mill they are sometimes simply panned up; the first panning is done in large prospecting pans in a tub or tank of convenient height filled with water, in which the tailings collect. The final panning of the amalgam is performed in pans, the bottom of which consists of a sheet of amalgamated copper, a little mercury being poured into the pan. This greatly facilitates the cleaning-up and collecting of the amalgam, which, being softened by the mercury added in the pan, adheres to the bottom. Any pieces of iron met with in panning are put on one side for treatment as described further on.[67]

i) Treatment of the Amalgam

The amalgam collected from the regular cleaning-up of the tables and the battery was stored in a safe place by the manager of the mining operation. Usually there was a mercury room off the mill in which a safe was installed to hold the amalgam collected in the clean-ups. The work space for the millman or assayer-manager consisted of a strong work table with a surface of stone or a hard-wood plank. In addition there would have been a supply of cups and pails of enamelled iron, amalgam knives, a supply of chamois cloth or canvas for squeezing the amalgam.[68]

If the amalgam contained too much mercury and was "too soft", it had to be squeezed. This was done by pouring the amalgam into the chamois which had already been well soaked:

> The free ends of the leather or canvas are then grasped in the left hand just above the point occupied by the

> amalgam and twisted round so as to prevent the latter from escaping; the whole is then immersed in water contained in a mercury pail or pan, and the gobular lump so formed twisted strongly with the right hand; by this means considerable pressure is put upon the amalgam contained in the skin or canvas, and the fluid free mercury is squeezed through the pores of the latter, until only a ball of hard amalgam remains behind, all the superfluous mercury having been squeezed out of it. 69

Following this operation the amalgam was retorted to separate the gold from the mercury. ILLUS. 76.

Before the amalgam was placed in the retort, its inside was coated with a material to prevent the gold sponge from sticking to it. Following is Louis' description of the preparation of the retort and the retorting process:

> The principle of this operation consists of heating the amalgam to a temperature above the volatilisation point of mercury, when this metal distills over, leaving the gold in a loose cellular state, in which it is known as gold sponge, the mercury being condensed by appropriate coiling apparatus. Practically, there are only two forms of retort in use in gold mills, the pot retort for small quantities, say up to 1,000 ounces of amalgam, and the cylindrical retort for larger amounts. Pot retorts are made in various sizes to hold from 250 to 1,000 ounces; the former are about 6 inches deep inside, and the latter 9 inches, the diameter being about 2/3 of the depth. The usual shape is shown in Fig. [22]. It will be seen that the retort consists essentially of two parts, namely the body and the cover, the delivery-pipe being screwed into the latter. These retorts are made of cast-iron and carefully turned inside. It is advisable to have the inside of the cover turned as well as the body; the joints between these two should be very accurately turned and be as true as possible. It is advisable to have a V-shaped projection on the face of the flange of the body which fits into a corresponding annular groove in the flange of the cover. A piece of good wrought iron piping is screwed onto the cover, its other end screwing into a stout Liebig condenser. This condenser consists of a pipe (of the same diameter as the retort outlet pipe) which passes axially through a short piece, 2 to 3 feet long, of a wider pipe so that an annular space, closed at both ends, is left all round the central pipe. An old mercury bottle answers capitally for the outer pipe. Two smaller pipes communicate with the top and bottom respectively of the annular space, water being supplied through the lower and escaping through the upper one. In its passage up it completely cools the heated vapours that are passing down through the small central

pipe. The retort is usually supported on a strong iron tripod, and may have a special furnace for heating it, although this is not necessary. Often a fire is built on the ground under and round the retort, the heat being concentrated upon the retort by laying a few bricks, or supporting some pieces of sheet-iron round it. The assay furnace does admirably for heating the retort; sometimes a smith's hearth is used, but this practice is not to be recommended. There are several methods by which the cover is secured to the retort body. The flanges may be clamped together, or they may be bolted together by three bolts passing through them, cotter bolts being better than screwed ones. Sometimes a semi-circular bale is used catching under the flange of the body, whilst a strong set-screw or sedge presses on the top of the cover. Of all these plans the last, illustrated in the above figure, is the best, as it is the least apt to be injured by the action of the fire. Before charging the amalgam into the retort, its inside should be coated with some substance to prevent the gold sponge from sticking to it. It may be well rubbed in with chalk or whitening, but the best coating consists of equal parts of finely ground fire clay and graphite made up into a thin paste. The retort should be washed out with this, and then put in a warm place so as to dry the coating. The same mixture worked up with water to the consistency of cream may be used for a luting between the flanges of the body and cover. It is also advisable to coat the outside of the entire retort with a similar mixture, to which a little fine asbestos has been added, as this preserves the retort from burning out rapidly. The balls of amalgam should be broken into two or three pieces each, and piled loosely upon each other in the retort, which should never be more than two-thirds full. A disc of stout asbestos millboard, just about 1/8 inch smaller in diameter than the top of the retort, should then be dropped in, a thin layer of lute spread on the flange, the cover put on, turned backwards and forwards a few times to ensure a tight fit, and then secured in its place. The retort is next placed on its tripod ready for heating and the condenser attached.

The end of the condenser pipe should be a few inches above the surface of water contained in a mercury pail, and should on no account dip below it. A strip of canvas should then be tied round the end of the discharge pipe so as to form a kind of loose tube dripping into the water, but care must be taken that this tube is not air tight. Sometimes a canvas or india-rubber bag is attached to the end of the pipe, but the above arrangements is preferable. A fire of small billets of wood, bark, or small brushwood is then built under and about the retort, the fire being preferably so arranged as to burn from above downwards, and the temperature very gradually raised until mercury begins to distill over. The heat of the

> fire must then be moderated so as just to keep the mercury distilling over in a gentle stream, but no more. The temperature of the retort should never approach redness as long as any mercury at all distills over. When no more comes over, the heat must be raised to redness, and kept at this point for a few minutes. The fire can then be removed, and the retort allowed to cool. The entire operation takes two to four hours as a general rule. It must not be forgotten that, as the mercury distills over and collects in the pail, the level of the water in it will rise, so that a little must be dipped out from time to time to prevent its rising above the mouth of the pipe. When the retort is cool enough to handle, the cover is taken off, the luting scraped off the flange, and the disc of asbestos board lifted out. The retort is then inverted over a piece of stout paper or a prospecting pan, when the sponge will drop out in one coherent retort piece, if the operation has been properly carried out. If the retort has been badly coated, or the heat too great, the sponge may adhere in places to the retort. It may then mostly be dislodged by a few taps of a hammer on the bottom of the retort, or, in extreme cases, a light hammer and chisel may have to be used. The object of the disc of asbestos board is to prevent spiriting, and the mechanical carrying off of any of the amalgam in the vapours of mercury. The sponge, when perfectly cold, is weighed and cut up with a hammer and chisel preparatory to melting.[70]

ii) Melting

The next step in the procedure would be to melt the remaining mass in a crucible. In a small mine operation the crucible could be heated on the blacksmith's hearth. The best material for heating the crucible was coke, but hard wood charcoal was also suitable to insure a sufficient melting temperature.

When the heating was complete, the substance in the crucible was a bright yellow colour. The fluid, if no further treatment was required, was then poured into an ingot.[71]

5.4.6 Concentration

During this later period of mining in Nova Scotia most gold mining companies installed shaking tables, frue vanners or Wilfley tables to treat the tailings that escaped form the amalgamation process. Although the gold in the province was largely "free milling" a portion of it was tied up with sulphides and other chemical combinations that prohibited recovery through amalgamation alone. Concentration was the means by which the auriferous portions of the tailings were collected in small portions for further treatment.

ILLUS. 56 interior of the Royal Oak Mill, provides an illustration of the arrangement of the Wilfley table below the amalgam tables; ILLUS. 51 Dufferin Mill, Salmon River, depicts the shaking tables installed below the amalgam table to catch and treat the tailings; ILLUS. 49 plan of Oldham Mill, shows the arrangement of the concentrator within this mill vis-à-vis the stamp battery and tables. The concentrator installed in the Oldham Mill, 1891, was a Golden Gate apparatus.[72] The Bluenose Mill at Goldenville installed two Wilfley tables to handle the tailings from its operation in 1900.[73]

Following is Louis' description of the apparatus available for concentration.

> Shaking tables - Nearly all the modern concentrating machinery used in gold mills belongs to this class, which includes the various forms of shaking-tables, of which there are endless modifications. Generally speaking, the shaking-table consists of a suspended inclined table upon which the tailings are delivered in a very thin stream. This table receives a rapid oscillating motion, the effect of which is to propel the lighter particles along one path, and the heavier ones along another, so that each may flow off into receptacles provided for the purpose. These machines are very effective and produce clean concentrates, whilst the loss in the tailings can be kept within very low limits. The original form of shaking-table is that divised by Rittinger, which has not been much improved on since, in which the direction of the shake is at right angles to the flow of the pulp. These tables are usually built in Paris, their general construction being shown in [ILLUS. 77 and 78], which represent Rittinger's original design, the first figure giving a section, the next a plan and the third a front elevation of the machine. The table

"is strongly made of hardwood, carefully planed and made as smooth as possible. It is suspended by four rods which allow its grade to be altered at will. The framing of the table is very substantial, and it carries a stout transverse piece near the middle, which receives a series of thrusts from a cam which pushes it against a strong wooden spring. The action of this spring throws it back sharply against a bumping-block, which gives the shake to the table, the shake thus consisting of a series of sharp shocks. Each table is usually 8 feet long by 4 feet wide, and has an inclination of from 3° to 6° to the horizontal. The average number of blows is about 100 per minute, but in working very fine sands as many as 150 per minute are sometimes given, the length of each stroke being about 1 1/4 inches. Above the upper end of the table is fixed a head-board with the usual distributing-pins. The pulp to be concentrated is delivered to one-fourth only of the head-board, the remainder being supplied with clear water. If the table were at rest all the particles of the pulp would tend to roll down the tables in lines parallel to its length, the heavier particles achieving the journey more rapidly than the lighter ones. The impulse due to the shaking action acts in a direction at right angles to the line of flow, and hence the particles move down in a line, which is the resultant of these two motions; the heavier particles, however, moving more slowly, are exposed for a longer time to the action of the transverse impulses than the lighter ones, and hence are thrown further from the straight line of flow. It is thus possible to obtain a very complete separation of the pulp into concentrates and barren sands, the action being quite continuous. This machine answers well, except in the case of very fine slimes. Each double table requires about 1/4 indicated H.P. ; one man can attend to two double tables without any difficulty. The capacity of a double table is about 3 1/2 to 5 tons per 24 hours; the consumption of water is considerable, being altogether about 0.5 to 0.8 cubic foot per minute, three-fourths of which amount constitutes the stream of clear water. In more modern forms the tables have been made of planished sheet iron, of slate, and of plate glass, whilst metal has been substituted for wood in nearly every part, the supporting frame being light castings, the spring, etc."

"The Wilfley Table: This concentrator is one of the most recent of this class of appliances, but has already met with a certain amount of success. Its general appearance is shown in [ILLUS. 79] it consists of a flat wooden table 16 feet long and 7 feet wide covered with linoleum, upon which are nailed a series of strips of wood gradually increasing in length from the back to the front of the machine and gradually tapering to nothing from a depth of about 3/8 inch at the motion end. The table slopes upwards about 1/2 inch from the motion end, and also slopes forward from the back; the amount of this latter inclination can be altered at will, according to the nature of the material that is undergoing treatment. The table is moved by an eccentric combined with a link and toggle, so as to have a quick forward and a slow backward motion; a spring keeps the table close against the motion the whole time, so that there is no shock or bump properly speaking. The pulp to be concentrated is fed on to the table from a head-board near the motion end for a width of some three feet; the rest of the table receives clear water only. When the table is in operation, quartz and other minerals of low specific gravity are carried by the stream of water down the table in a practically straight line; heavier bodies sink below the edge of the riffles, are thus unable to escape straight down the table, and are hence gradually moved along it by the series of impulses to which they are subjected; they are only capable of being carried by the water current when they have moved clear of the riffles, hence a particle of mineral on this table moves in a direction that varies from nearly parallel with the length of the table to nearly transversely across it, according to its size and specific gravity, or, if particles of practically uniform size are alone considered, they move according to their respective specific gravities. Clean tailings run at once to waste, middlings are returned by a small raff wheel to the head-board, and the heavier minerals are discharged at different points of the table in accordance with the principle already stated. The great advantage of this table is that it makes a very clear and distinct separation upon various species of minerals; it does not however do equally good work upon unsized pulp, hence it should be preceeded by spitz-lutten or some other form of automatic classifier. A table is intended to treat about 30 tons of ore per 24 hours, but has exceptionally been found capable of taking up to 50 tons; in some American mills one table is put in to every ten head of stamps. It requires about 1 H.P. to run it, and should be driven at 240 three-quarter inch strokes per minute. The supply of clear water required varies greatly with the character of the ore to be" "concentrated; it may be said to range from 5 to 20 gallons per minute. The weight of the table is about 22 cwt,"[74]

Chemical milling processes were not used in the Goldenville area during the 19th century, although there were attempts in other parts of the province, most notably, North Brookfield Mines.[75]

END NOTES

5.4 The Stamp Mill

1. A. Heatherington, MINS, Annual Summary, Gold Yield of Nova Scotia, 1862-'73. There were 53 mills in the province, 19 of which were water-powered. In Goldenville there were 9 steam mills and 3 water-powered mill operations.

2. Map 4, GSC Sherbrooke Gold District, 1893. H. Y. Hind, Report on the Sherbrooke Gold District, Map of Sherbrooke Gold District, PAC 45, v.145, Notebook XLVII, 1884, Aug. 30, 1884, p.30.

3. H. Louis, op. cit., p.491: "... the great principle must always be remembered that, for economic workings the ore should never be lifted from the time it enters the battery until it escapes after the final treatment, in the form of exhausted tailing, but should continuously descend from stage to stage moved by gravity alone." Many of the mills constructed during both periods of goldmining in Nova Scotia failed to follow this rule of thumb. See H. Y. Hind, Report on the Waverley Gold District, Halifax 1869, p.57. Hind criticized the location of the Waverley crushing mill as being too low, "the tailings as they leave the mill, are now required to be hoisted by a revolving wheel, furnished with buckets, to a sluice" so that they could escape over the accumulated tailing dump situated by the mill. PANS MG 1, Cantley Letterbook, Blue Nose Gold Mining Company, 3 Feb., 1900 and 10 January, 1900 correspondence re: the need for a pump to lift the tailings as they come from the stamp mill.

4. H. Louis, op. cit., p.490.

5. See Endnotes, Section 5.3.3 of this report.

6. J. C. Murray, op. cit., p.3; Woodhouse, op. cit., p.21; F. H. Mason, p.5. N. S. RDM, 1899. The Royal Oak Mill was constructed within 600 feet of the shaft.

7. E. Gilpin, "The Gold Fields of Nova Scotia", p.2: "... in every district a very considerable quantity of gold is stolen by the miners".

8. Neily Correspondence, J. B. Neily, Goldenville, to R. V. Neily, Goldenville, 8 August 1914.

9. H. Louis, op. cit., p.491.

10. H. Louis, op. cit., p.491.

11. J. G. McNulty, "Observations on Gold Mining", Transactions of the Mining Society of Nova Scotia,... 1903, p.100: "The provision for ample room and light are too often neglected in the average mill structure." See discussion re: battery frame arrangement to maximize working space and available light. "Twentieth Century Mine", Industrial Advocate, Feb. 1903-04, p.40.

12. H. Louis, op. cit., p.261.

13. J. E. Hardman, op. cit.

14. J. E. Hardman, op. cit., p.40. H. Louis, op. cit., p.263 - figure 67 and 69.

15. B. T. A. Bell, ed., op. cit., 1899, p.77-78.

16. N. S. RDM, 1901, p.49-50.

17. H. Louis, op. cit., p.114-115.

18. Ibid. p.103-107.

19. J. E. Hardman, op. cit., p.35-36.

20. N. S. RDM, 1899, ; B. T. A. Bell, ed., op. cit., 1899. N. S. RDM, 1902. Nova Scotia Mining Number, (Halifax), 1903.

21. H. Louis, op. cit., p.109-112.

22. Ibid. p.110-111.

23. See Hardman's Mill Plan for location of ore-bins. H. Louis, op. cit., p.112.

24. The rock breaker at the Blue Nose was located at the deckhead of the main shaft along with a 40-ton ore bin. From the shaft the ore was transported in a skip up an incline to the mill ore bins, which had a 125-ton capacity. N. S. RDM, 1901, p.49.

25. PAC RG 45 Notebook 4451 (1899) Dufferin Mines, Salmon River, Sept. 13, 1899. The stamp mill illustrated in Gilpin's 1882 "Gold Fields of Nova Scotia" was also manufactured by Fraser and Chalmers. Not all mines used automatic feeders, even though they were recommended. The five-stamp battery mill operated by Edgar Horne at Renfrew, 1978 has an automatic feeder made from a carriage spring.

26. Nova Scotia Mining Number, (Halifax), 1903.

27. J.E. Hardman, op. cit., p. 35.

28. Ibid. p. 37. The mortar blocks for the Oldham 10-stamp mill were built in one solid piece"... one solid piece of timber 30 inches wide, 14 feet deep and 12 feet 2 inches long".

29. Prof. H. Sexton, "A Gold Stamp Mill for Laboratory Testing", Journal of the Mining Society of Nova Scotia, V. X, 1905-06, p. 126.

30. William Neily, Interview, Tape 1, Side A: "A lot of millmen didn't like it [the concrete] unless they had a thickness of rubber belting or something underneath it [the mortar] to pick up the shock. The cement was too much of a shock and it would split the battery. I think most of them were wooden foundations".

31. Prof. H.H. Sexton, op. cit., p. 126.

32. H. Louis, op. cit., p. 125-26. Hardman makes no reference to this procedure in the construction of the mortar blocks for the Oldham mill. It was unlikely that he used concrete to shore up the foundation but more likely a combination of quartz, slate and tailings.

33. H. Louis, op. cit., p. 126-27. Del Mar discusses mortar foundations in Stamp Milling, op. cit., p. 79-92.

34. F. Gilpin, op. cit., Illustration of 10-stamp mill, 750 lb. stamps, in research file, Sherbrooke Village, op. cit., p. 232: "These A frames do very well for small and light mills, but are not recommended for stamps over 750 lbs. They have been almost entirely replaced of late years by the so-called knee-frame..."

35. J.E. Hardman, op. cit., p. 36.

36. Ibid.

37. H. Louis, op. cit., p. 235-238. Algernon del Mar, op. cit., p. 73. Mar disliked the front knee pattern style because it "had the disadvantages of cutting out light from the battery plates and [had] proven weak with heavy stamps requiring a back-knee brace to give stability. The only point in its favor [was] that the tight side of the driving belt is uppermost..." According to del Mar by 1912 the "A" frame style was seldom seen.

38. Ibid. p. 74, pp. 77-78, pp. 92-95.

39. McAlpine's Directory, Nova Scotia 1890-'97, p. 462. Truro Foundry and Machine Company. This industry was intricately involved in gold mining operations in the province. The director of the Dufferin Gold Mine at Salmon River was G. Clish (Truro) and all the members of the Board of Directors were from Truro. Clish was also President of the Truro Foundry. Canadian Mining Manual, 1893, p. 129.

40. McAlpine's Directory, Nova Scotia 1890-97, p.966. Matheson's Foundry, New Glasgow.

41. Industrial Advocate, June 1897, p.1, Windsor Foundry.

42. Ibid, November 1896, "Goldenville at the Present Day", p.15. Our Dominion, 1887, p.133.

43. PANS, RG 21, Series "A", v.20. Correspondence - George Dawson, G. S. C., to E. Gilpin, 28 April 1899.

44. H. Louis, op. cit., p.128-132.

45. Ibid. p.131-32.

46. J. E. Hardman, op. cit., p.38-39.

47. E. Gilpin, op. cit., p.17. Gilpin's 10-stamp mill employed both front and back inside copper plates. Henry Louis argued against the use of rear plates inside the mortar box because they seriously reduced the crushing efficiency of the stamps. op. cit., p.152-53.

48. J. E. Hardman, op. cit., p.38-39; "This copper strip is placed on a bar of square iron, and from 1/4 to 3/8th of an inch in width, is bent over at right angles for the whole of its length. It is then fastened to the rounded screws, the longer side sloping upwards toward the screen at an angle of about 45 degrees with the horizon, while the shorter side inclines towards the stamps at an equal angle, forming a narrow V-shaped trough.

49. H. Louis, op. cit., p.149-153.

50. B. T. A. Bell, ed., op. cit., 1897. PAC 45 v. 146, Notebook 4451, September 13, 1899.

51. J. G. McNulty, "Observations on Gold Milling" in Transactions of the Mining Society of Nova Scotia, p.97. H. Louis, op. cit., p.132-135. Louis recommended the frames "be made of strips of wood 1 1/2 inch thick and 3 inches broad, the screens tacked to the inside of the frame, and a strip of blanket the exact width of the screen frame tacked over it."

52. H. Louis, op. cit., p.132-135. The longevity of the screen was related to the material of which it consisted, steel perforated plate or woven wire mesh. The perforated screens lasted considerably longer, but were much more expensive. Thus a number of the woven mesh screens would equal the same cost as one perforated plate. Because of the possibility of screen damage, Louis recommended that each mill maintain a duplicate set of screens, so that if there was a breakage, etc., the mill would not have to be shut down while it was repaired and replaced. The screens were held in place by means of "two long steel (or oak) keys at either end, and one or two shorter wedges at the bottom".

53. Ibid. p.135-36.

54. A. L. Carr, "Treatment of Low-Grade Ores of Nova Scotia", Industrial Advocate, Jan. 1903, p.13.

55. H. Louis, op. cit., p.163-66.

56. Ibid. p.175-183.

57. Ibid. p.173-174.

58. Ibid. p.191-200.

59. M. R. O'Shaughnessy, op. cit., p.118. In research files, Sherbrooke Village.

60. Ibid. p.120-21.

61. H. Louis, op. cit., p.302-307.

62. Ibid. p.307.

63. Ibid. p.310.

64. Ibid. p.310-311.

65. Ibid. p.318.

66. Ibid. p.319.

67. Ibid. p.421-426.

68. Ibid. p.433-34.

69. Ibid. p.435-436.

70. Ibid. p.440-443.

71. Ibid. p.447-448; p.452.

72. J. E. Hardman, op. cit., p.39.

73. N. S. RDM, 1900, p.38-39; PANS, MG1, Cantley Papers, Correspondence, 24 April 1900. Letter to Truro Foundry requesting price list of Wilfley tables, delivered either to New Glasgow or Halifax.

74. H. Louis, op. cit., p.350-355; p.360-362.

75. B. T. A. Bell, op. cit., 1899, p.77-80; W. Malcolm, op. cit., p.112-117.

6. Sherbrooke Village and A Gold Mining Exhibit

6.1. Potential Themes and Exhibits:

The history of the gold mining operations of Goldenville is a rich field. There are countless themes that could be developed in association with an exhibition about 19th-century Nova Scotian gold mining methods and technology. In this report I have divided the period into three distinct phases - 1861-1872: 1873-1893: and 1894-1906.

Given the strong tendency for Nova Scotian miners and entrepreneurs to persist with traditional methods of mining while experimenting with new systems, it would be quite feasible to illustrate the old and the new within one exhibition on the development of mining methods in the 19th century .

Some of the themes that could be developed are:

a) the development and impact of gold mining technology focusing on labour, the village landscape, local industrial development, as well as the costs of developing and opening a gold mine in the 1890s compared to the 1860s;

b) the impact of the discovery of gold on the social and economic patterns of the St. Mary's River District - an examination of the inter-relationship between gold-mining, lumbering, and shipping (use of wood in the mines to fire the boilers; the shipment of coal into the area; etc.), the impact of the decline of gold-mining activities on these other activities; the growth of temperance legislation to control the miners, as well as a look at other activities fostered to "control" the gold miners; the development of schools, churches, and social organizations for the mining areas;

c) the relationship between Goldenville, Cochrane Hill, Crow's Nest, Country Harbour, Wine Harbour - the geological formation of the area; the development of the mining claims and the movement of men, equipment, companies and capital between these areas;

d) the relationship between Goldenville and other mining districts in the province. There appears to have been a group of mining interests that virtually dominated the gold mining areas on N. S. in the latter part of the 19th century - George Stuart, John Hardman, E. Faribault, just to name a few. It would be interesting to illustrate the inter-relationships between certain companies and developments in the province;

e) In addition to the movement of leading mining figures - engineers, geologists and entrepreneurs - the labourers moved from area to area. As one district closed up, they'd move to another, be it in Nova Scotia, the Western United States, the Klondike Northern Ontario or Quebec. The mobility of the mining populations from 1849 right through to 1906 would be another fascinating element.

f) Throughout the 19th century, overspeculation was cited as the main cause of the failure of the Nova Scotia gold fields. It continued to be used as a reason for lack of investment in this century. The relationship between the mines of Goldenville and the stockmarkets on London, New York, and Toronto would be an interesting topic - there are numerous prospecta available both for Goldenville Companies and other areas that tout the wealth to be had through investment in the natural resources of these regions. The story of George Hirschfield would exemplify the ability of entrepreneurs to attract capital into Goldenville.

g) The impact of gold mining on the environment: the former site of the Blue Nose Gold Mine in Goldenville is bordered by a marshy area. Part of the ground cover gives the appearance of an industrial operation once being located there. The Environment Protection Branch (EPS) of the Federal Department of Environment has been doing some investigation of the impact of gold mining on the environment. It would be interesting to have the area of land near the old Blue Nose sampled to identify what industrial wastes have been left behind.
In addition there is also the controversy about the relationship of mining and arsenic contamination of the water table. A presentation of that theme as well as the above would link the past activity with the present.

The key to an exhibit ought to be the reconstruction of a stamp mill. Since the available stamp mill was manufactured in Truro in 1888, what we know of this ought to provide the framework for a mill reconstruction. Although mining activity of this period was marked by new technology, new methods and theories about gold mining, many of the methods from the 1860 and 1870 period continued to be used. Many old timers preferred to work with hand steel, doubting the efficiency of the new air and steam hammer drills. It was still a period when individual miners would pool their resources and expertise to prospect and open up a small mine. The miners of both the small claims and the larger-scale operations, by and large left the gold fields for the summer harvest, suggesting that the labour force in some ways had not changed greatly in manner and attitude since the earlier phase of developments.

By using available photographs and plans (such as the plan of the Oldham mill), the expertise of retired miners and millmen, as well as the expertise of men such as Edgar Horne and Gerald Logan, it shoud be possible to assemble the mill equipment within a structure representative of the 1888-1900 period. Since "custom mills" continued to exist throughout the later period, as well as during the earlier phases, it would be feasible to consider a mill in this light. It would not be necessary to locate it on top of the gold field.

However, the question of location is an important and difficult one. Mills were never built within Sherbrooke. In Goldenville, the mills, houses, waste rock dumps, churches, and tailing dumps were all intermingled with one another. Not only did Sherbrooke and Goldenville look different from one another, it would appear that Sherbrooke and Goldenville had a considerably different social structure. The mines were central to the existence of Goldenville and dominated the landscape and the village life. However in Sherbrooke there was a variety of economic activity. Patterns of life appear to be much more ordered, perhaps prohibiting the construction of a stamp mill within the residential and commercial village.

In addition, the needs of a 19th-century mill would have to be considered - access to water supply to facilitate the milling operation; solid bedrock foundations for the mortar block of the mill; sufficient space for a tailing dump, at a level great enough so that the tailings could virtually flow out into the dump by means of gravity rather than by hoisting them out. The feasibility of reconstructing a stamp mill will have to be considered carefully.

Rather than reconstructing a gold mine shaft, consideration should be given to using the Hirschfirld prospecting tunnel at Sonora. This tunnel demonstrates the skill and tenacity of the hard rock miners and it was completely done by hand. Models and photographs could be used to illustrate the system of underground mining that was developed within the province during the 1890s phase.

6.2 The Artifacts

6.2.1 Artifacts in the Collection

At Sherbrooke Village

1 ten-stamp mill manufactured by the Truro Foundry, 1888 consisting of 2 five-stamp mortars, cams manufactured by I. Matheson & Co., New Glasgow, stamp stams, stamp bosses, shoes and dies (It is questionable if all the parts are operational); used at Miller Lake.

1 portable steam boiler, manufactured by Waterous, Brantford, Ontario;

1 upright boiler, no manufacturer's mark;

1 hoisting device, manufactured by Clark and Chapman and Curney, Gateshead;

1 hoisting bucket;

1 small stone jaw crusher, no manufacturer's mark;

1 stamp mill model (N. S. M. Accession # 76.316.3)

At the Nova Scotia Museum (Halifax)

1 stamp mill, I, Matheson Foundry, New Glasgow (N. S. M. #70.13, Uniacke Storage);

1 mining cannister for gunpowder (N. S. M. #18.9) It is claimed that the cannister contained the gunpowder with which James G. Dunbrack fired the first shot to extract hold from his claim at Tangier, 1861. See H. Pier's records (4606).

1 gold miner's pan used in the Oldham Gold District, c.1862. Used by the original owner up until 1918. (N. S. M. 27.72)

1 crucible, used in Waverley gold mines (N. S. M. 67.84.3)

1 candle holder or candle hook, wrought iron; used by gold miners underground, (N. S. M. 16.20 and also 04.24)

6.2.2 Additional Requirements (A Partial List)

Stamp Mill

- driving belts
- ore bins
- ore skip or tramcar to haul ore into the mill
- amalgam dish (Photograph 34 - Dufferin Mine Stamp Mill)
- amalgam tools - palette, chamois, india-rubber (Photograph 44)
- kerosene lamps for lighting the mill
- amalgam table(s)
- concentrating equipment - either Wilfley table or frue vanner or blanket system
- mercury containers
- miner's scales
- steam engine to operate mill equipment; coal from Cape Breton

Mining

- air or steam drill; air compressor connected to mill engine.
- assortment of hand tools for underground work - hammers, hand steels, crowbars, shovels, etc.
- mine pump
- loading stick
- charges, fuses
- dynamite bag

- supply of miner's candles

Miscellaneous

- mining prospectus
- mining maps showing claims - Map 1, coloured according to original;
- lease agreements
- necessary government forms for making annual returns

6.3 Resource People

Informants and Consultants

During the research period for the attached report I was able to interview a number of men connected with the gold mining operations of both Nova Scotia and Ontario. There are a great many more people who should be interviewed to complete the picture of mining operations in the early years of this century, as well as the period from 1920 to 1942. Following is a list of the people with whom I did speak as well as suggestions of further contacts.

Contacted:

Name	Location	Topic
John Hartlen	Waverley	Gold Mining, Research
Richard Durdle	Goldenville	Miner, Mining in Goldenville
Jim Lesley, Jr.	Goldenville	Site of old mines in Goldenville
Wallace MacDonald	Glenelg	Underground work - Goldenville c. 1918-1942
Frank Jordon	Sherbrooke	Liscomb Power Plant (Assaying)
William Neily	Mill Village	Stamp Mill Operations
Gerald Logan	Upper Stewiacke	Stamp Mills (Mill operation at Lake Charlotte)
Edgar Horne	Enfield	Stamp Mill Operations (Has an operating 5-stamp mill at Renfrew)
A. Lomas	Halifax	Materials collected, Goldenville
Jim Morrison	Halifax	Researcher, Gold Mining in Queens County
Mathew McGrath	Sonora	Miner, Wine Harbour and Northern Ontario
Avard Hudgins	Truro	Geologist; Prospector

Potential Contacts:

Barn Taylor	Enfield	Miner/Assayer (Works with E. Horne, recommended by W. Neily)
Mr. Logan	Upper Stewiacke	Gerald Logan's father; miner in Caribou area, c.WWI and on
Carl Monroe	Port Dufferin	Miner
Fred Redden	Middle Musquodoboit	Mining, stamp mill operations
Harold Barron	Sherbrooke	Millman in Goldenville, Miller Lake
J. P. Messervey	Halifax	Former Deputy of Mines; in Dept. of Mines c. 1920s- 1950s
J. P. Nowlan	Halifax	Former Deputy Minister of Department of Mines, N. S.
M. G. Goudge	Halifax	Former Inspector of Mines, Department of Mines, N. S.
Mrs. Harold Mason	Goldenville (summers)	Teacher in Goldenville, husband was a miner in area; familiar with history of mining
Harry McEachran	Goldenville	Miner, mining
Bernard Slaunwhite	Chelsea, Lunenburg County	Miner

Consultants:

A number of the men with whom I spoke expressed considerable interest in a Sherbrooke Village gold mining exhibit. Two men, William Neily (Mill Village) and Edgar Horne (Horne Settlement, Enfield), both recommended to me by Avard Hudgins (Truro), were particularly interested in the reconstruction of a ten-stamp mill.

William Neily, nephew of a former manager of the Goldenville Mines, (Vernon Neily c. 1914-1917), learned his trade from his uncle in British Columbia during the 1920s. He later worked in the mining operations of Kirkland Lake, Timmins, Rouyn-Noranda, as did a great number of Goldenville and Nova Scotian miners. Since his return to Nova Scotia, he has been mainly engaged in prospecting in some of the old gold districts of the province, Oldham and

Mill Village. Neily loaned me his copy of Henry Louis' A Treatise of Stamp Milling, (2nd edition, London: MacMillan and Co. Ltd., 1899).

Neily has had experience in all phases of gold mining and offered his assistance to Sherbrooke Village.

Edgar Horne, a descendant of the founder of the Horne Mine in Rouyn-Noranda, P. Q., recently set up a five-stamp mill in the Renfrew Gold District. Horne dismantled and transported the stamp mill, which was manufactured by I. Matheson, New Glasgow, from Molega, Queens County to Renfrew, Halifax County c.1976-77. In addition to the mill, he acquired a 33 h.p. diesel engine (Ruston-Hornesby) manufactured in London, England. The engine had been dismantled after the Molega operations closed down in the mid-30s and was stored in a local barn in feed bags. Horne had the task of re-assembling the engine and getting it into working order, which he did with the assistance from Ruston Diesel Engines and Gas Turbines, Dartmouth.

The mill was set up in a steel frame building close to a pit that Horne hoped to work in the spring of 1979. Barn Taylor, Enfield, assisted Horne in assembling the 5-stamp mill with its automatic feeder and amalgam tables. It is in working operation, and ore from Renfrew, Cochrane Hill, and Crow's Nest has been crushed in the mill.

Horne would be an ideal resource person in the reconstruction of a stamp mill in Sherbrooke Village. In addition to supervising the selection of an appropriate site and pouring the mortar block foundations, his experiences in setting up his own mill would be of great assistance in putting the Miller Lake 10-stamp mill into operation.

In addition to his mill work, Edgar Horne has had experience in operating both large and small crushers. In his collection of mining equipment he has a large Massey Co. crusher and a smaller version, manufactured in Welland, Ontario (from the Molega site).

The only area where it does not appear he has had much experience is in the operation of steam engine equipment. But the five-stamp mill in Renfrew is set up with the diesel engine in the same fashion as the ten stamp-operation would be with steam.

Additional photographs as well as mining artifacts may possibly be borrowed from Frank Jordon, Sherbrooke Village, and the Sherbrooke Historical Association. Mr. Jordon has a number of twentieth-century photographs of mining activities:

- 2 stamp batteries of the Ventures Gold Co. Mill, Goldenville
- Interior of Liscomb Power Plant
- Goldenville shaft and mill, c.1920s
- Construction of houses in Goldenville
- Construction of power dam at Liscomb

A. Lomas, Sherbrooke Historical Society has a collection of late 19th-century as well as 20th-century gold mining photographs:

- N. S. and Mexican Gold Mining Co. Office, post. 1912
- Small mining operations, pumps, etc., c.1860-1890
- Shaft and mill building of Ventures in 1930s
- Letter from John H. MacDonald to his father about mining activities in another district in Nova Scotia, c.1884.
- Collection of mining artifacts

7. List of Illustrations, Descriptions and Negative Numbers.

The illustrations have been produced on pages separate from the text

List of Illustrations, Descriptions and Negative Numbers Continued.

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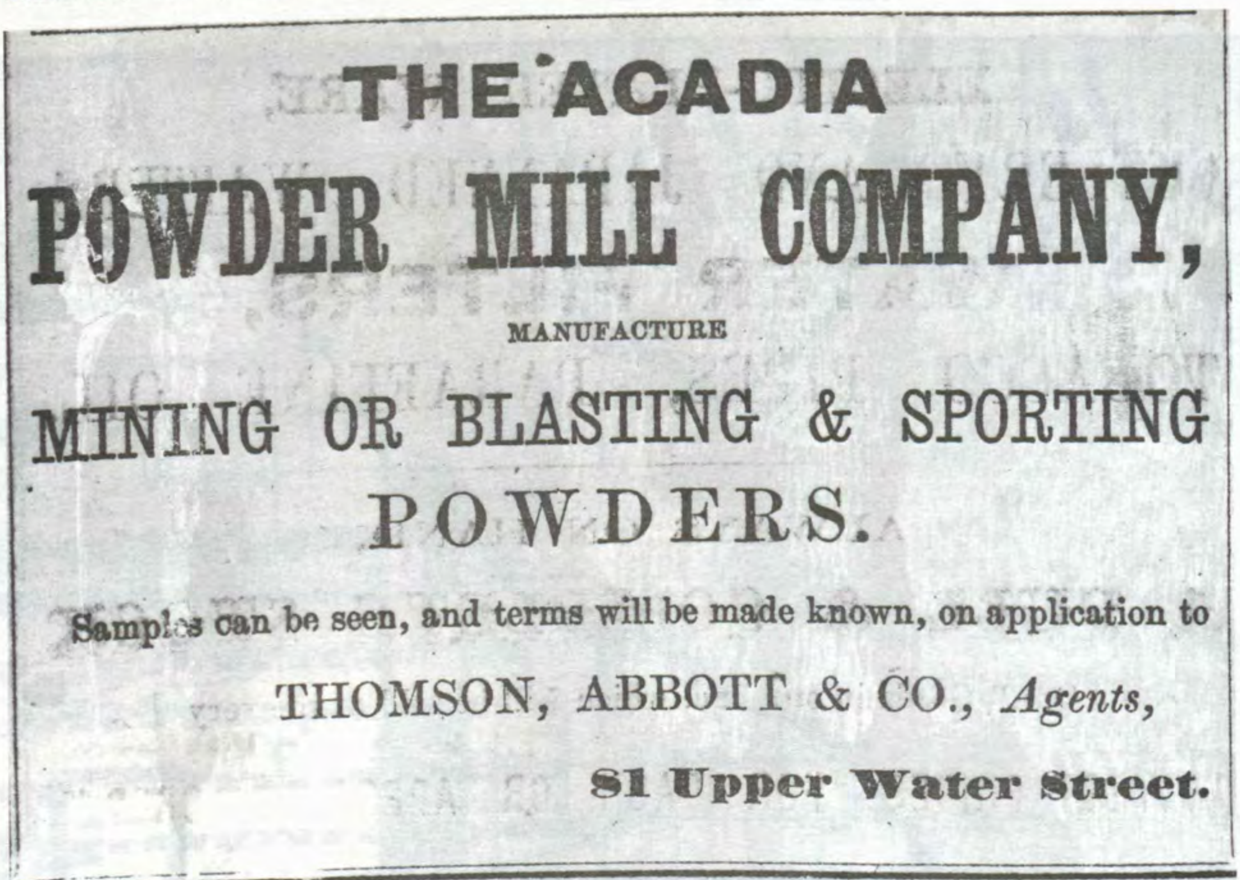
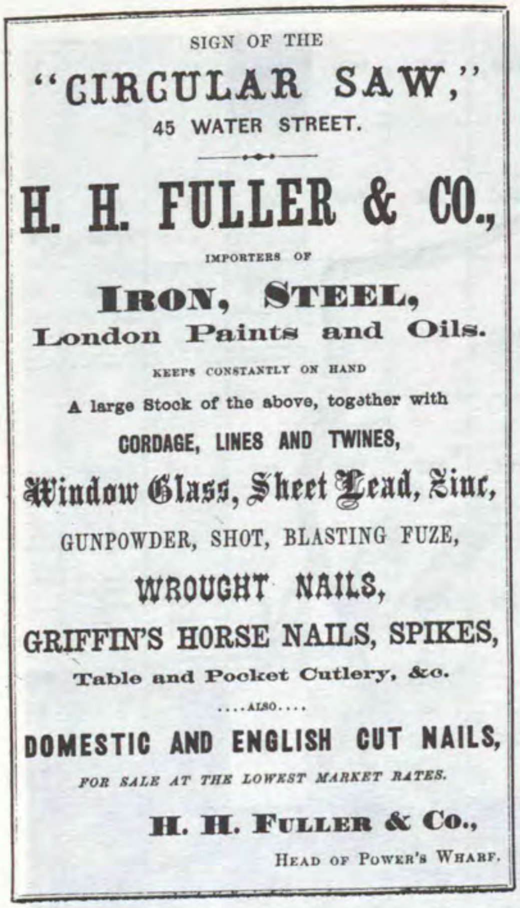
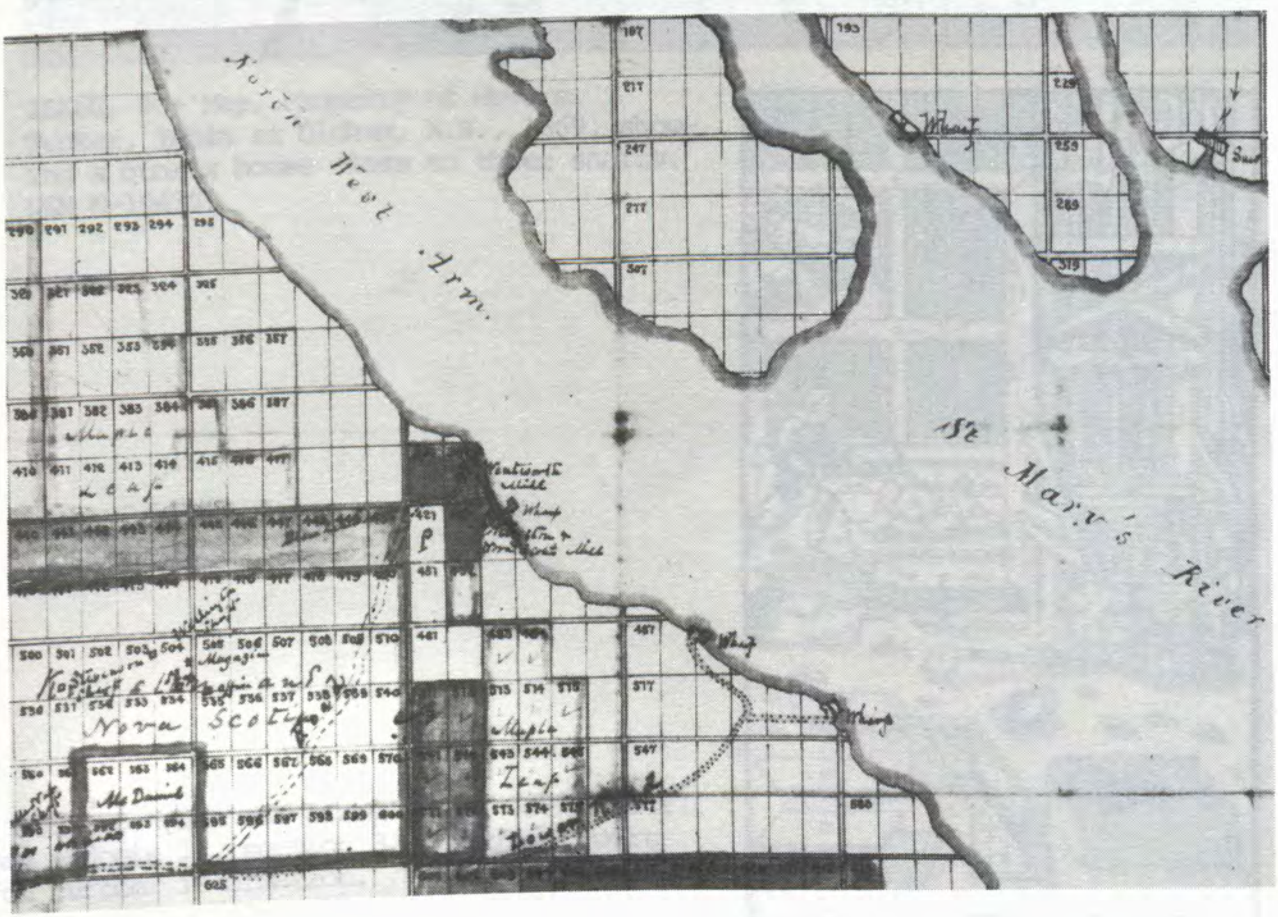


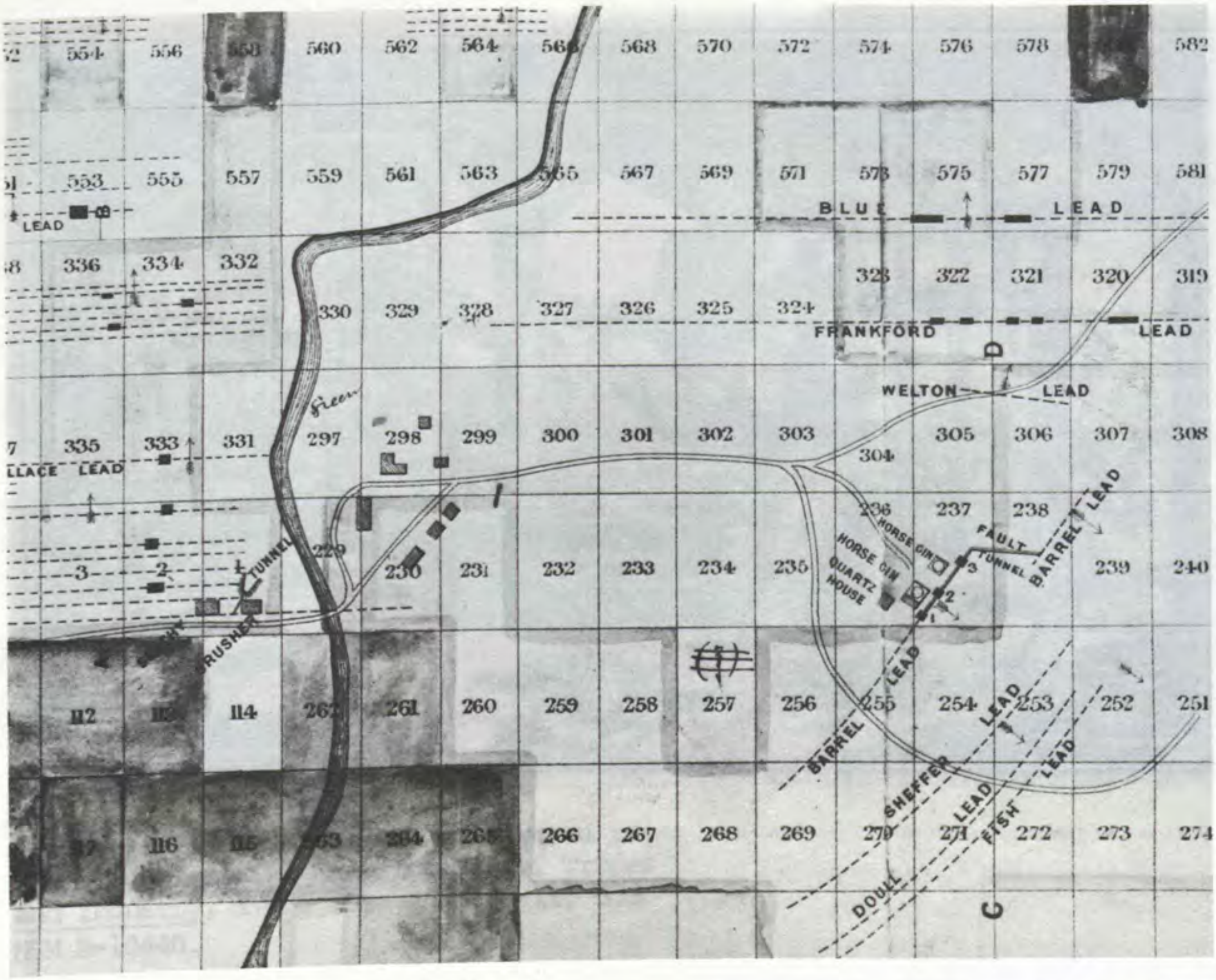
ILLUS. 6 - Advertisement - Acadia Powder Mill. Belcher's Almanac, 1865, p. 28. NSM N-10426.



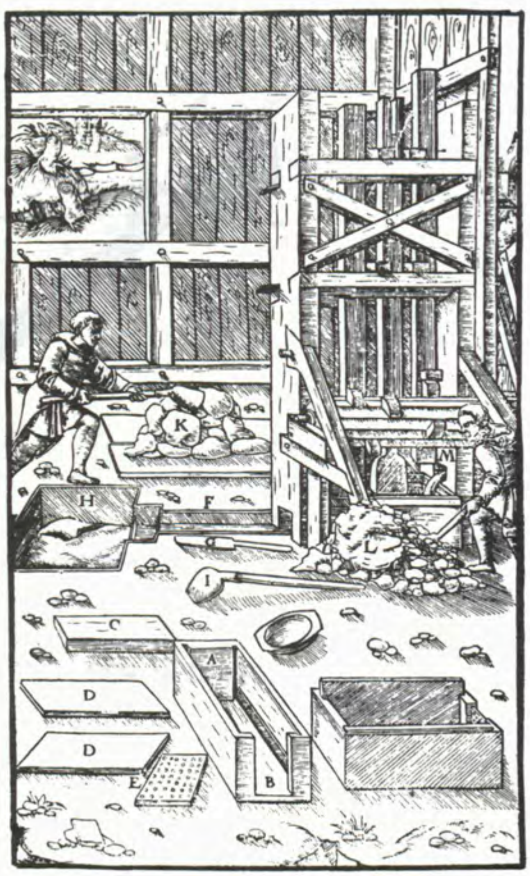
ILLUS. 7 - Advertisement for H.H. Fuller in Belcher's Almanac, 1865, p. 68.

ILLUS. 8 - Map, Sherbrooke Gold District, 1870. PAC H2/219.

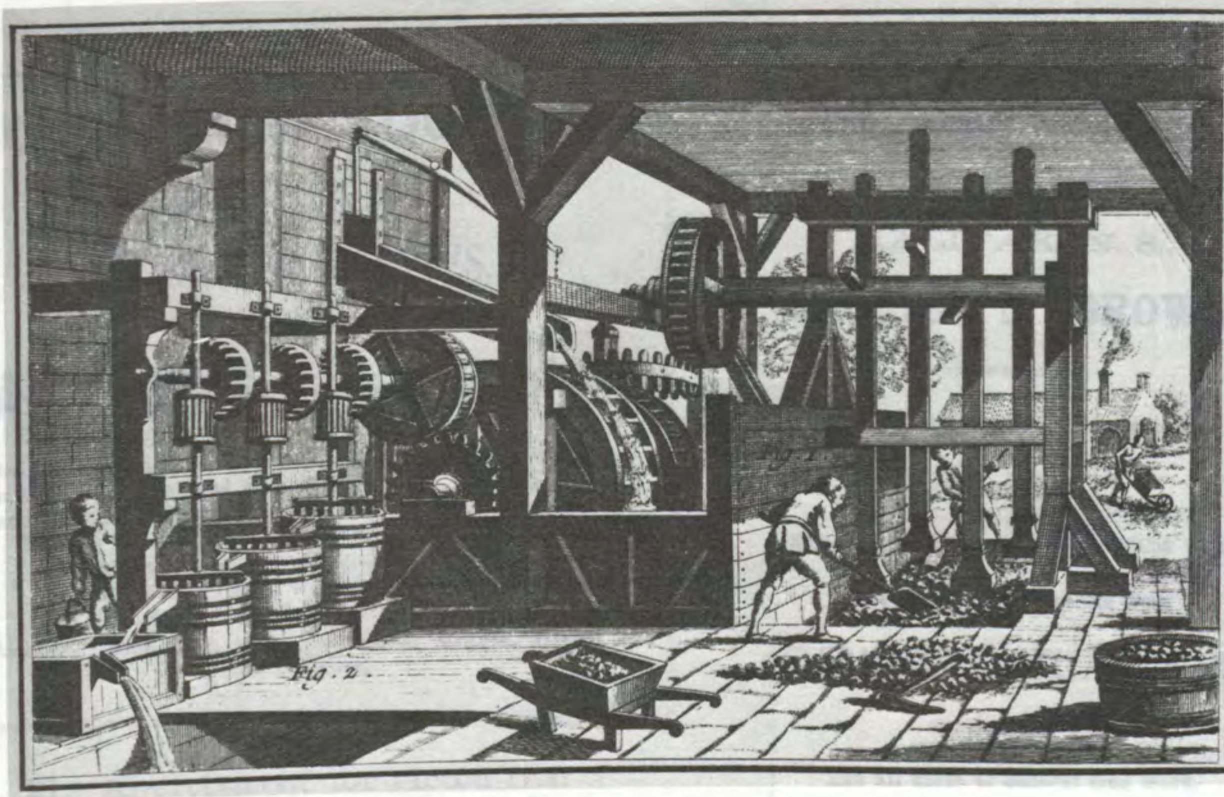




ILLUS. 9 - Map, Property of Messrs. Tucker, Tobin at Oldham, N.S., 1869, showing a quartz house close to three shafts. NSM N-10438.



ILLUS. 10 - Ancient Stamp Mill. NSM N-10427. See endnote 11, section 3.3 of this report for further information. NSM N-10427.



ILLUS. 11 - Stamp mill as illustrated in Diderot, Pictorial Encyclopedia of Trades and Industry, 1763. See endnote 11, 3.3 NSM N-10440.

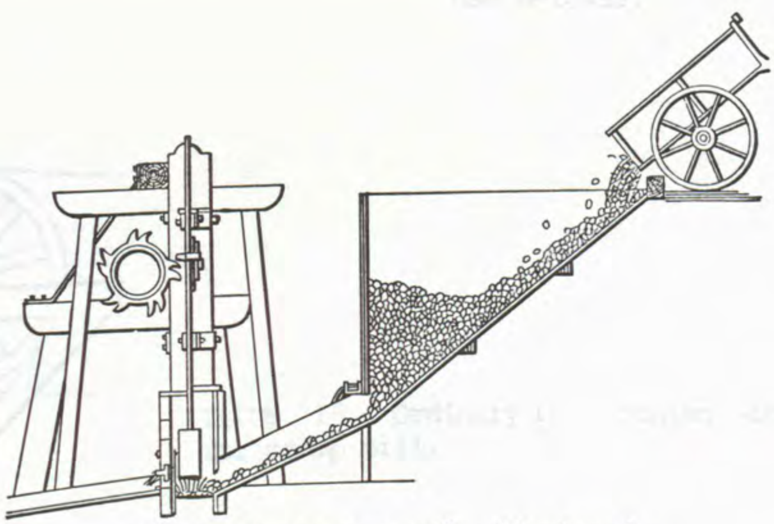


FIG. 2.—Cornish stamp mill. (*Henderson.*)

ILLUS. 12 - Cornish Stamp Mill. NSM N-10428.

PICTOU IRON FOUNDRY.

PICTOU, N. S.

WILLIAM H. DAVIES,

MANUFACTURER OF

STEAM ENGINES of every description,

Quartz Crushers and Amalgamators on the most improved plan. Machinery for Grist and Saw Mills, Fulling Mills, Shearing and Napping Machines, Tanners' Bark Mills and Leather Rollers, Shingle and Threshing Machines, Tobacco Screw Presses, &c., &c. All kinds of Brass and Iron Castings, Patent Windlasses, Capstans, Winches, and all kinds of Ship Work,

Also, Cooking, Parlor, Shop, and other Stoves, Register Grates, and Ships' Cabooses.

ILLUS. 13 - Advertisement for Pictou Iron Foundry in Hutchinson's Directory, 1864-1865. NSM N-10423.

DIRECTORY.] HALIFAX. 103

CITY IRON FOUNDRY,

NO. 18 HURD'S LANE,

HALIFAX, N. S.,

GEORGE S. BROWN,

PROPRIETOR.

Ship Work of every description,

MILL WORK,

IRON SHOP FRONTS, & ALL OTHER HOUSE WORK,

Iron Railings and Ornamental Work,

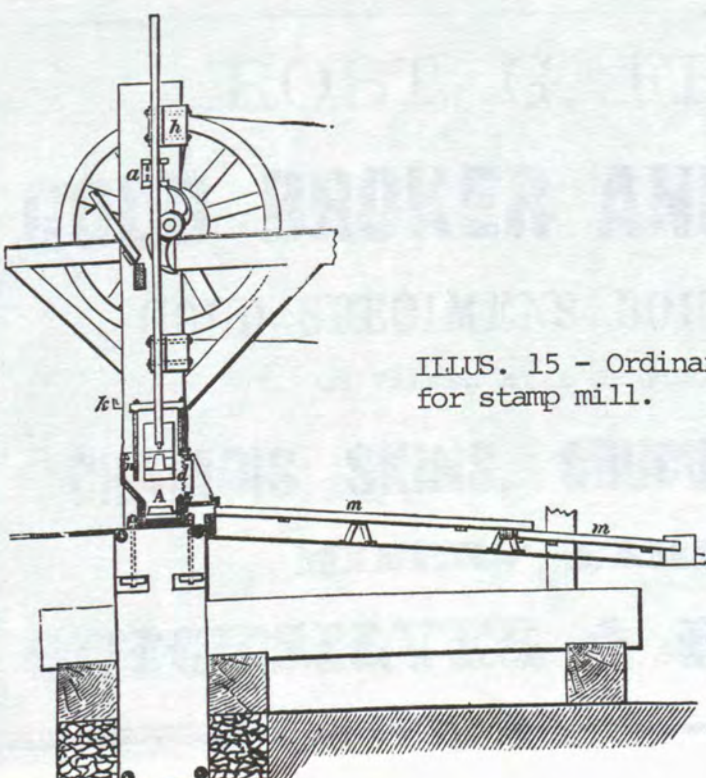
QUARTZ CRUSHERS

OF ALL DESCRIPTIONS,

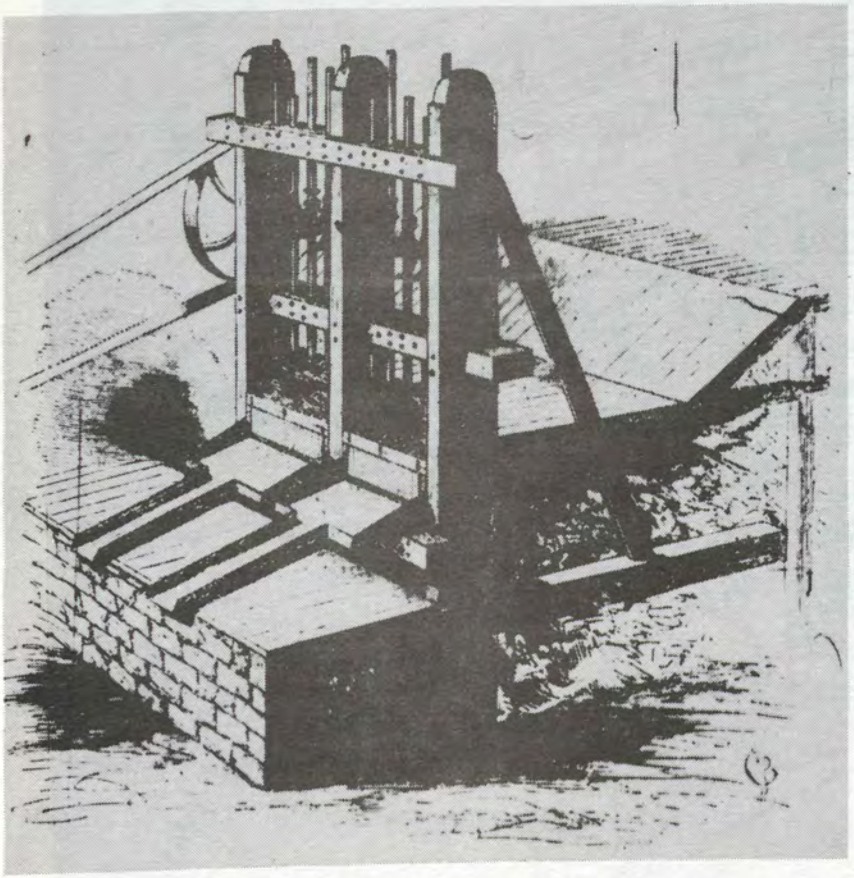
And all kinds of General Iron Work,

MADE AT THE LOWEST PRICE AND ON THE SHORTEST NOTICE.

ILLUS. 14 - City Iron Foundry, Halifax, in Hutchinson's Directory, 1866-67. NSM N-10439.

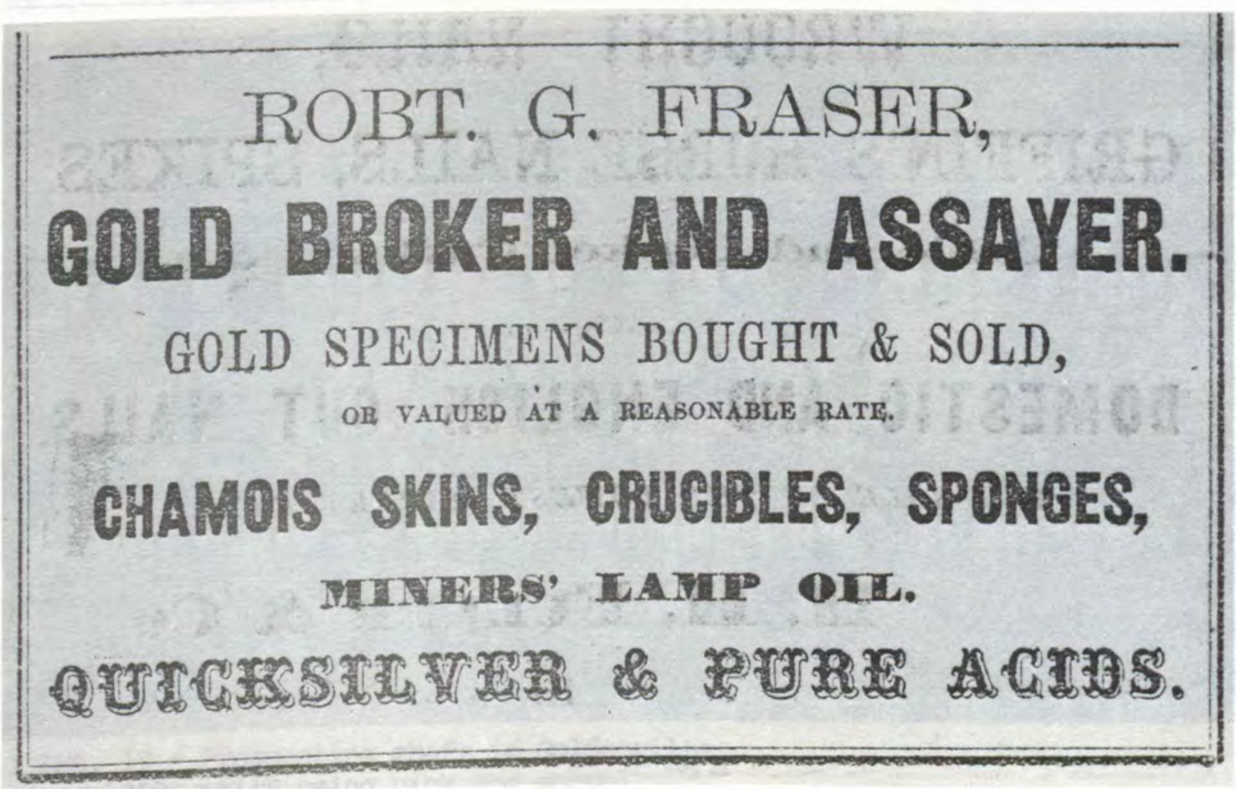


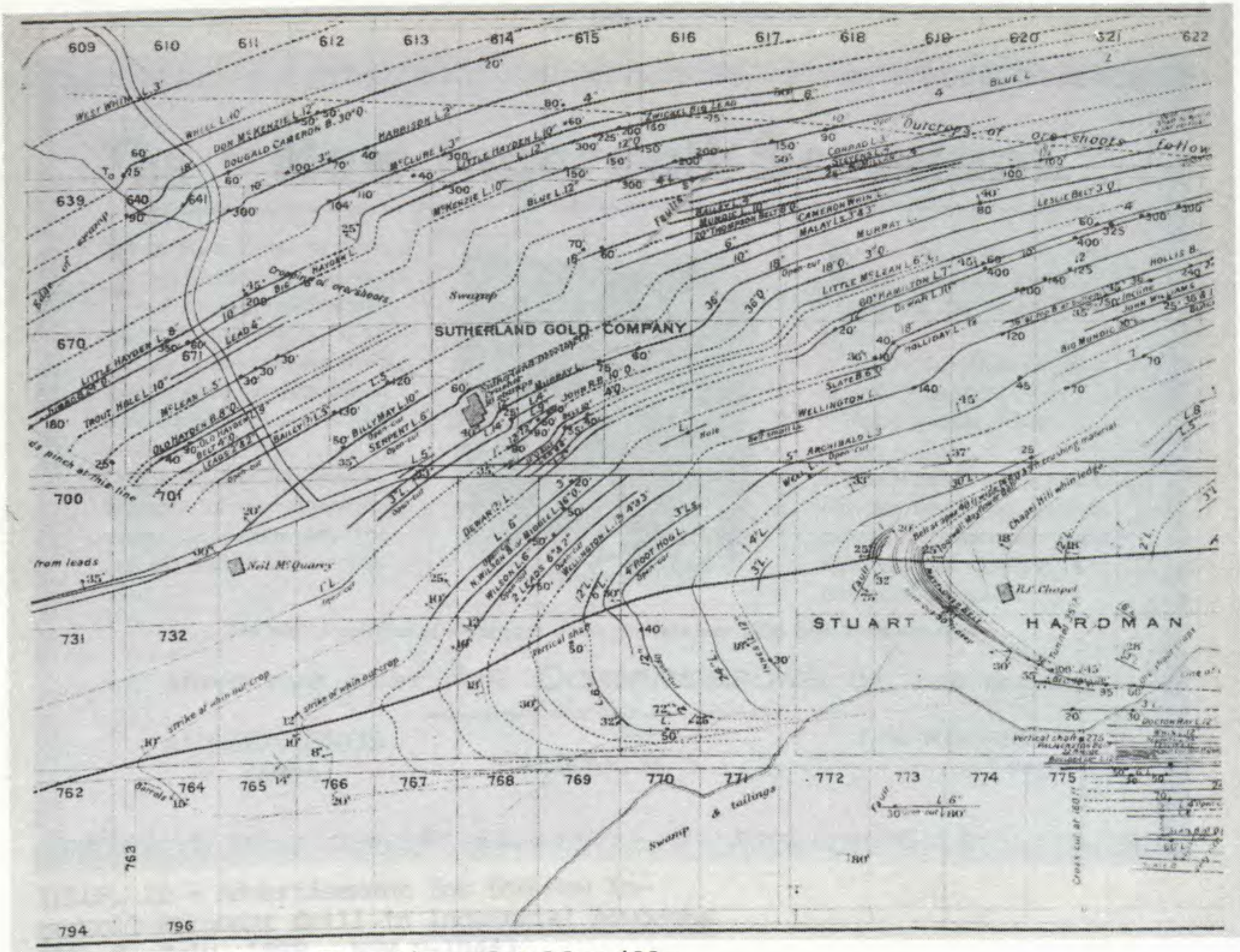
ILLUS. 15 - Ordinary Californian pattern for stamp mill.



ILLUS 16 - Messrs. Mory and Sperry's 10-stamp battery, American design. NSM N-10,430.

ILLUS. 17 - Advertisement, Robert G. Fraser, Chemist and Druggist... Chamois Skins, Crucible Sponges in Belcher's Farmers' Almanac, 1865. NSM N-10424.

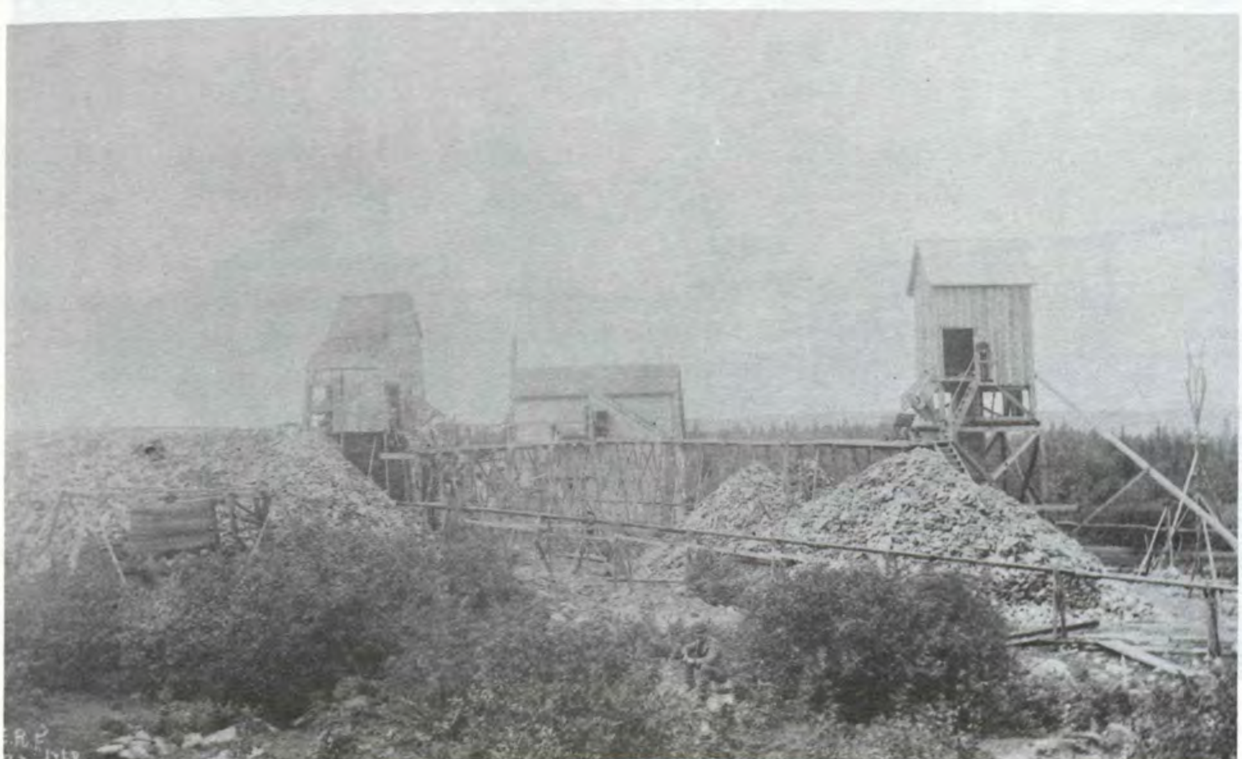




ILLUS. 18 - Plan and section of Goldenville Gold District, 1893, in W. Malcolm, Gold Fields of Nova Scotia. NSM N-10441.

ILLUS. 19 - Prospecting shaft in Goldenville, circa 1920, still using pick and shovel. NSM N-4409.

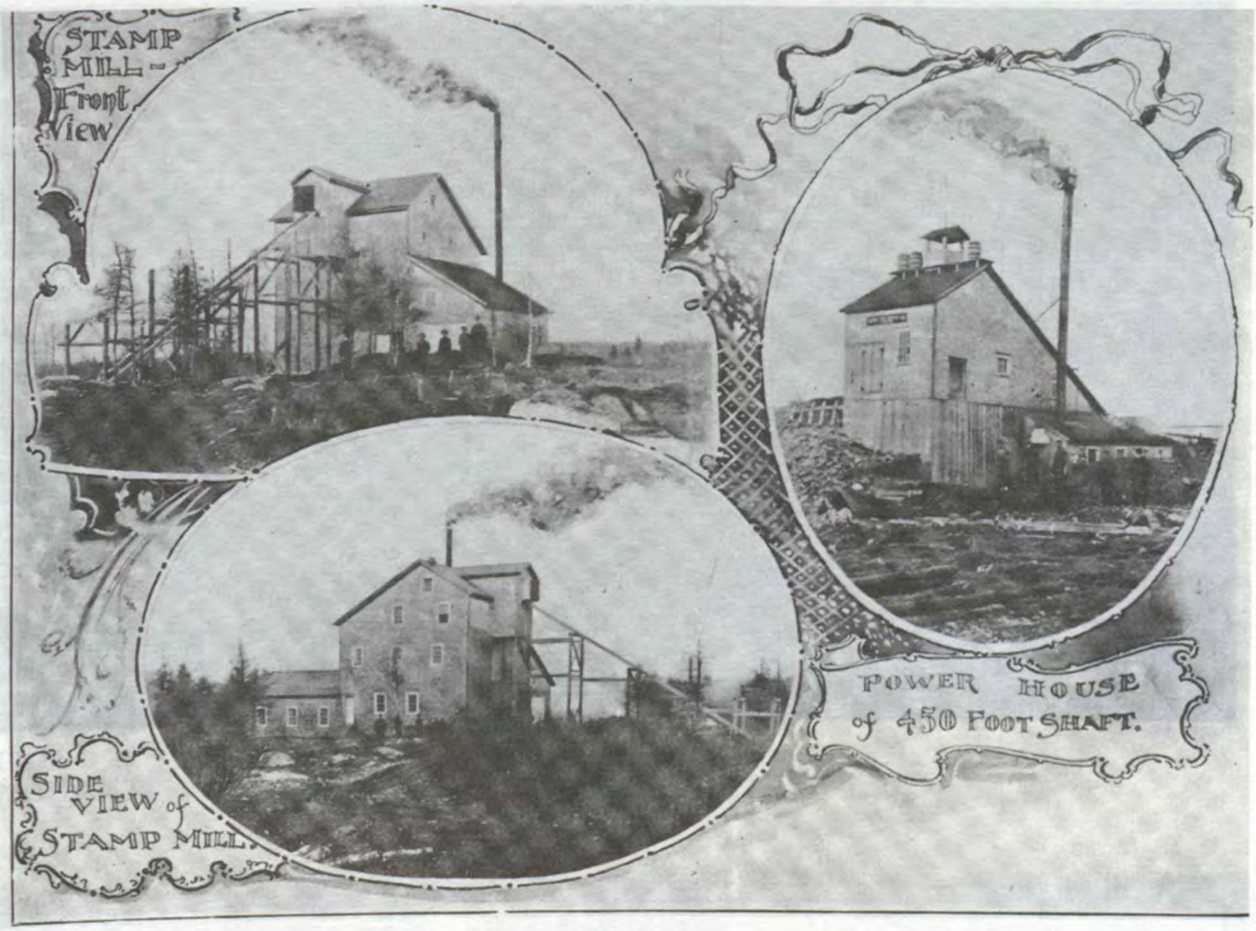
ILLUS. 20 - Advertisement for the New Ingersoll-Sergeant drill in Industrial Advocate III: 9, July, 1898. NSM N-10443.



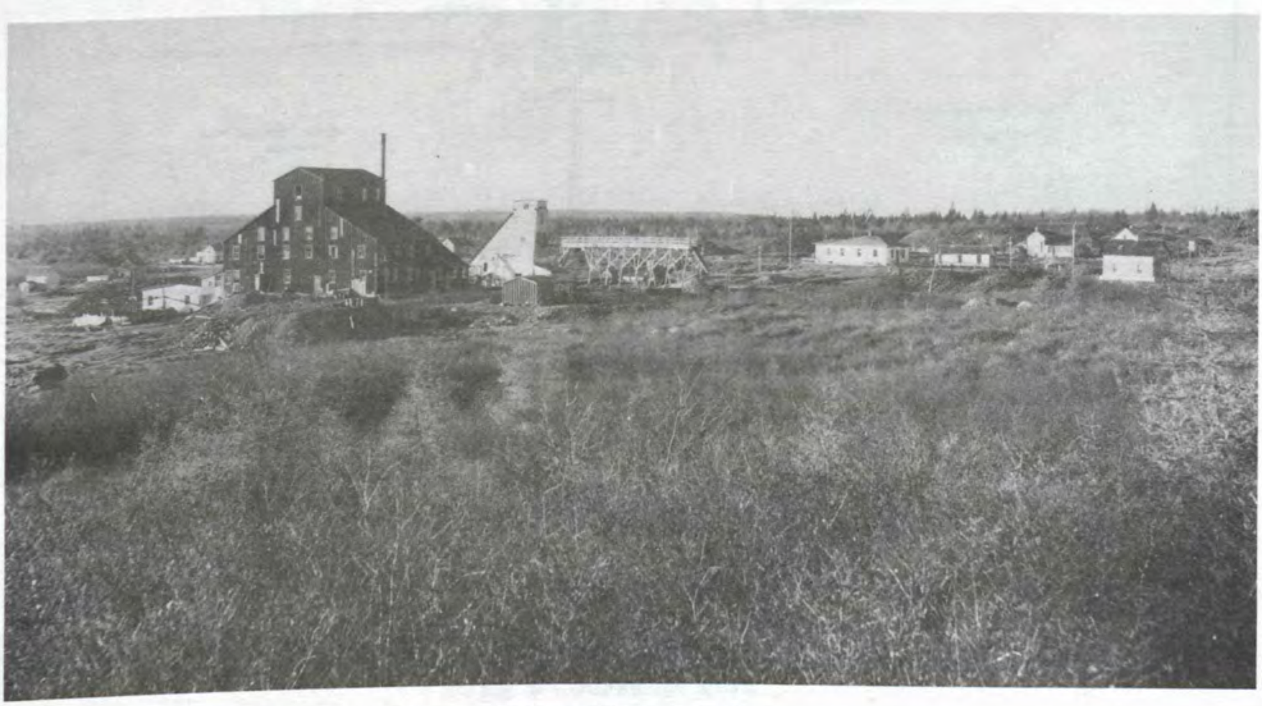
ILLUS. 21 - Shaft structures. Bluenose Mining Company, 1897. PAC 39881. Tramways for ore cars connect to mill building in centre.

ILLUS. 22 - Shaft structures. New Glasgow Gold Mining Company, 1897. PAC 51444. Tramways connect to mill building at right.

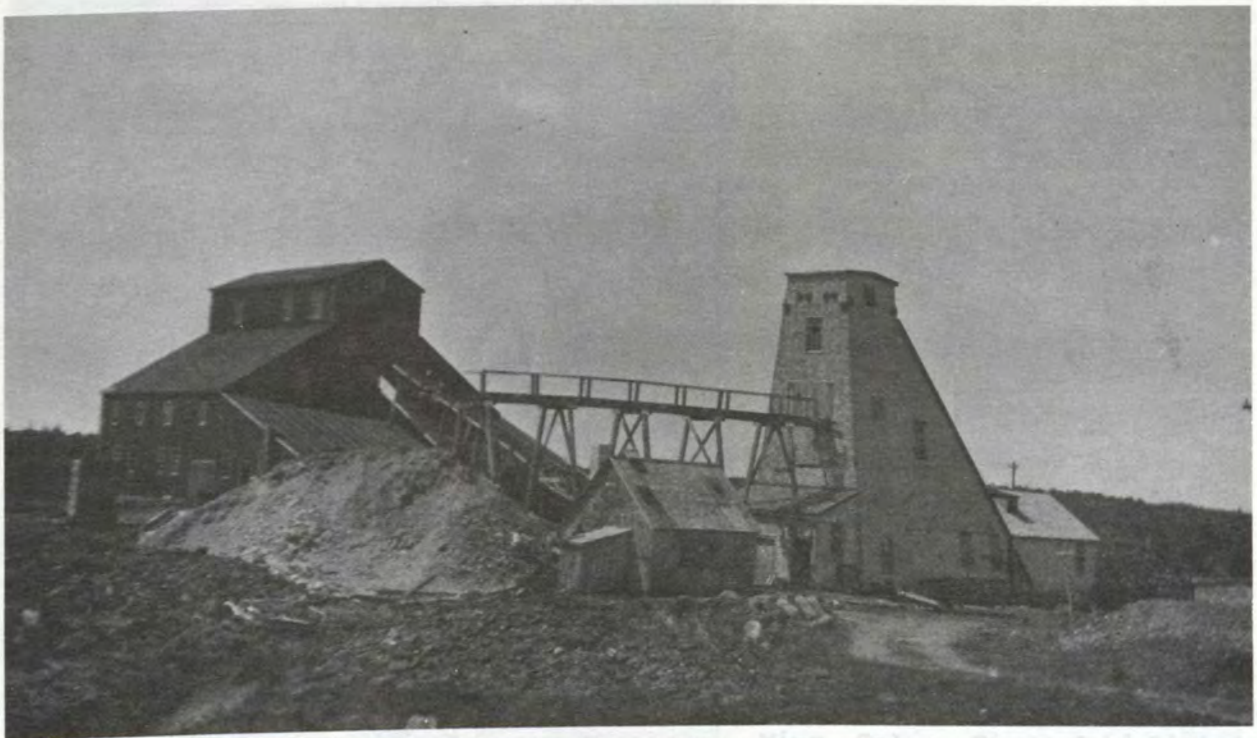
ILLUS. 23 - Bluenose Gold Mining Co., mill, 1897. PAC 39884. Tramways lead to mill building. The smoke stack indicates that the engine and boilers were situated on the ground level.



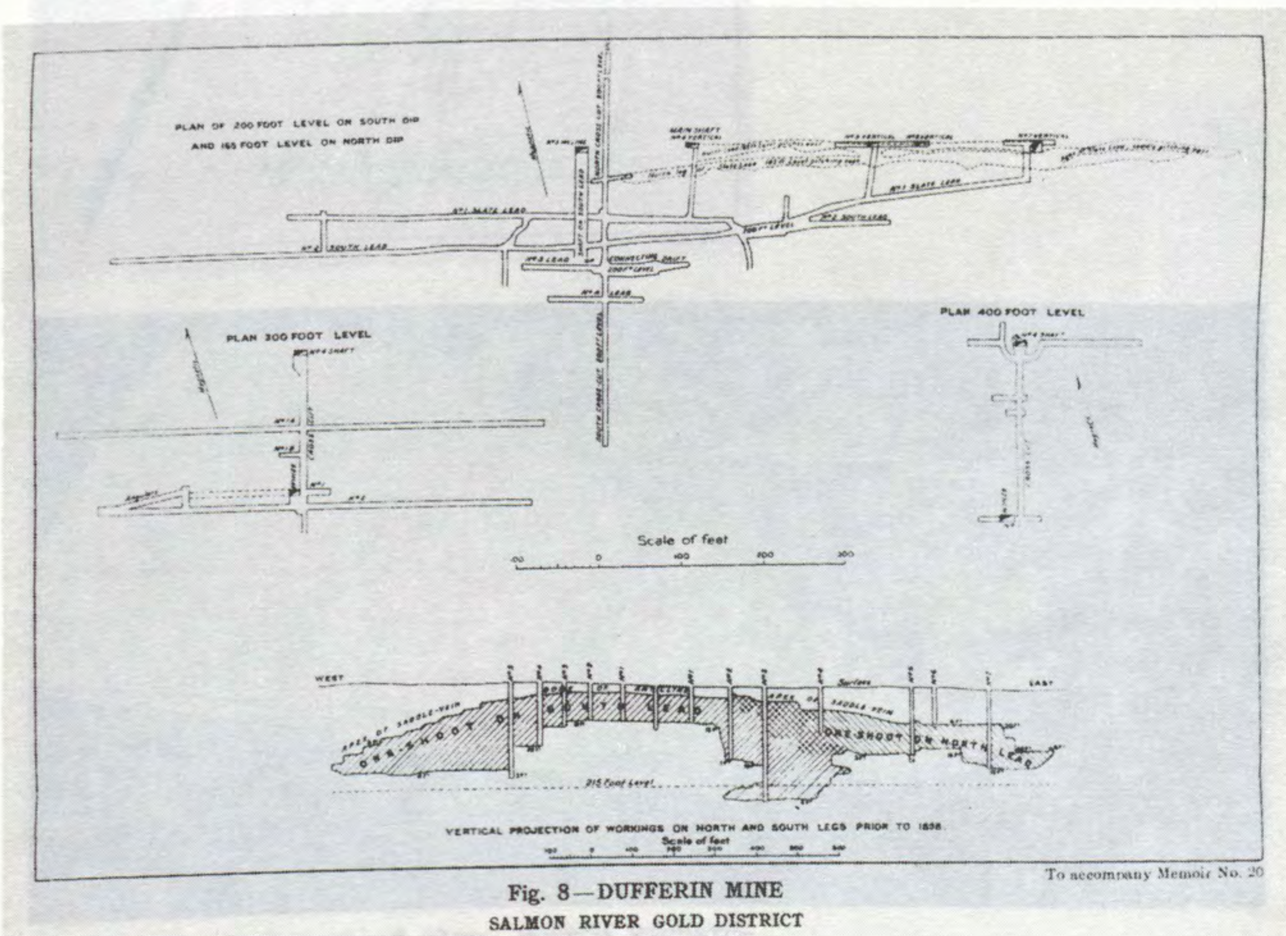
ILLUS. 24 - Royal Oak, 1902. NSM N-10431.



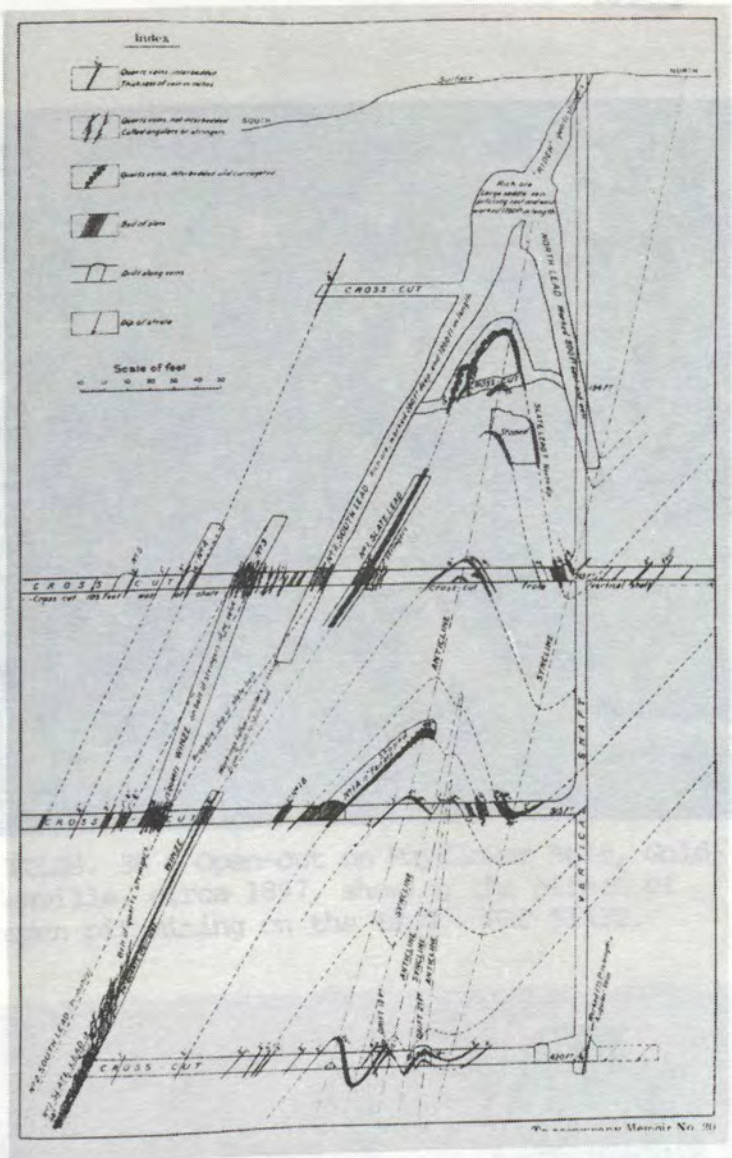
ILLUS. 25 - Shaft and mill. Goldenville Gold District, circa 1925. N.S. Dept. of Mines.



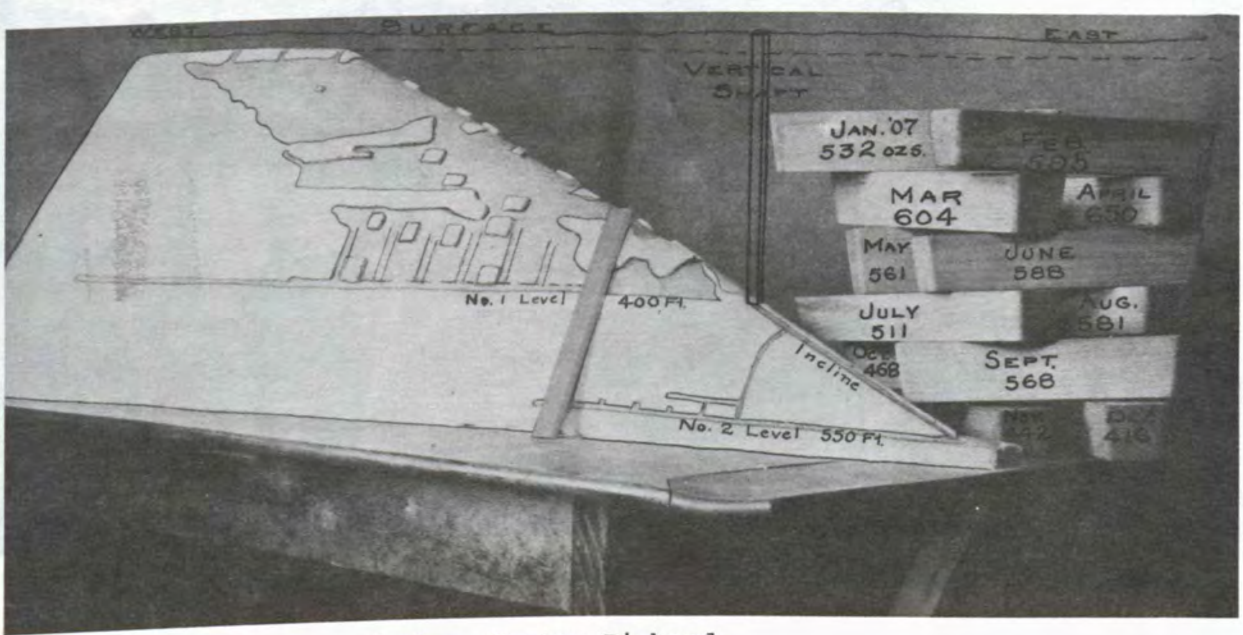
ILLUS. 26 - Goldenville Shaft and mill, 1934.
PAC 14667.



ILLUS. 27 - Cross-section, Dufferin Mine, Sal-
mon River Gold District. NSM N-10518.



ILLUS. 28 - Cross-section, Dufferin Mine, Salmon River Gold District. NSM N-10444.



ILLUS. 29 - Underground plan, Boston Richardson Mine, illustrating the use of multiple shafts and the single vertical shaft systems. NSM N-7005.

ILLUS. 30 - Open-cut on Mayflower Belt, Goldenville, circa 1897, showing the effect of open pit mining on the land. PAC 51432.

ILLUS. 31 - Open-cut, Goldenville, 1934. PAC 14668.

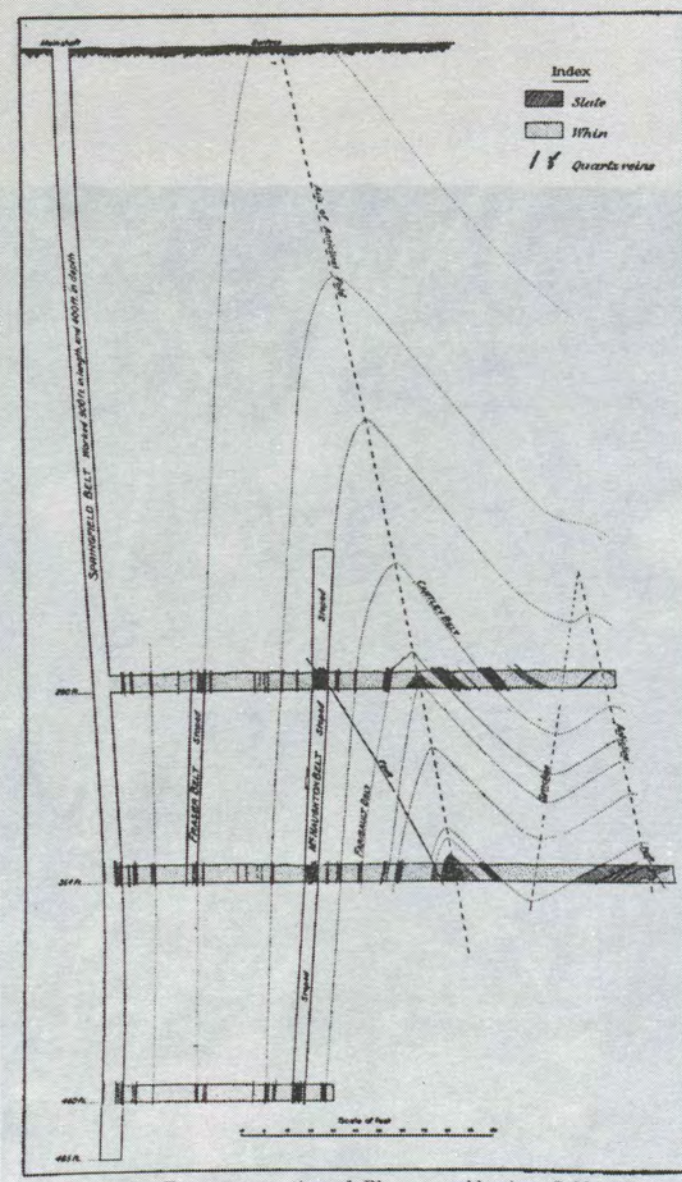


Figure 6. Transverse section of Bluenose gold mine, Goldenville.

ILLUS. 32 - Transverse section, Bluenose Mine, Goldenville, showing series of cross cuts from the main shaft, intersecting a number of veins. 1900. NSM N-10442.

ILLUS. 33 - Ore being loaded into ore-car from chute connecting the stopes at the Baltimore and N.S. Gold Mine, Caribou, circa 1904. The man working at the ore chute would be classified as a mucker. See reference to chutes on page 69, this report. NSM N-5193.

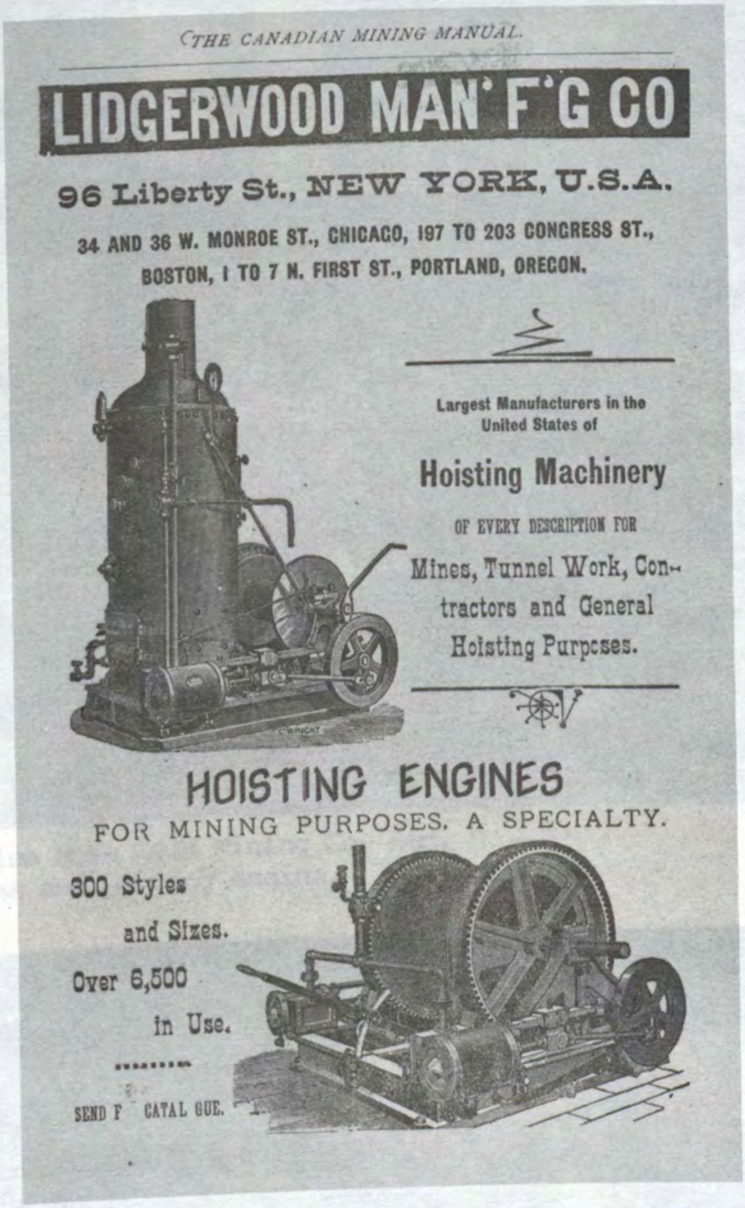
ILLUS. 34 - Ore-car in shaft house, having been brought to the surface for sorting, Baltimore and N.S. Gold Mine, Caribou, circa 1904. NSM N-5192.

ILLUS. 35 - Prospecting shafts, Goldenville, circa 1897. PAC 53513.

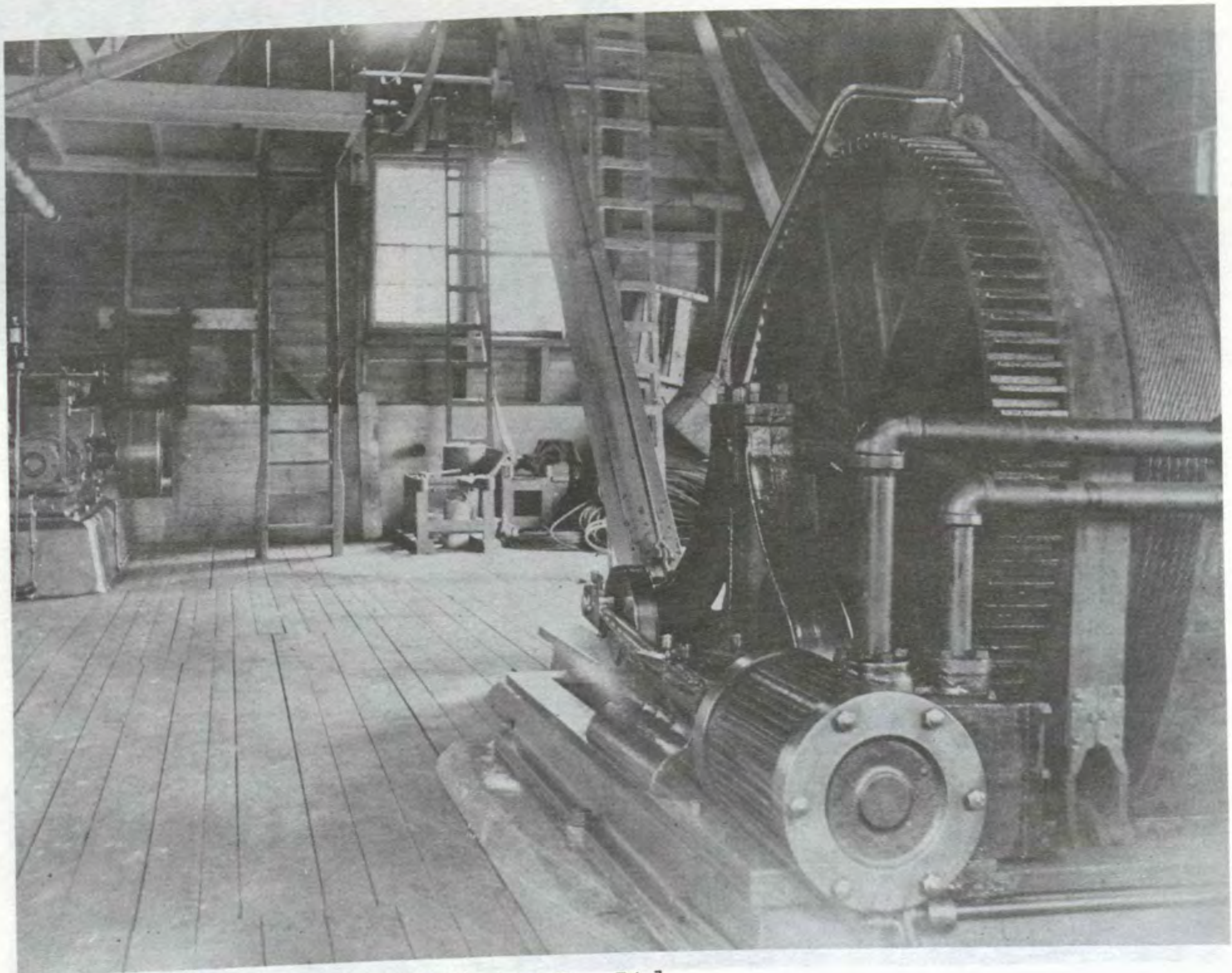
ILLUS. 36 - George Hirschfield's mine, Goldenville, circa 1897. Note whip in left-hand corner. PAC 39891.

ILLUS. 37 - Shaft. Cold Stream Mine, Gay's River, late 1880s. Note boiler and pipes in background. NSM N-5195.

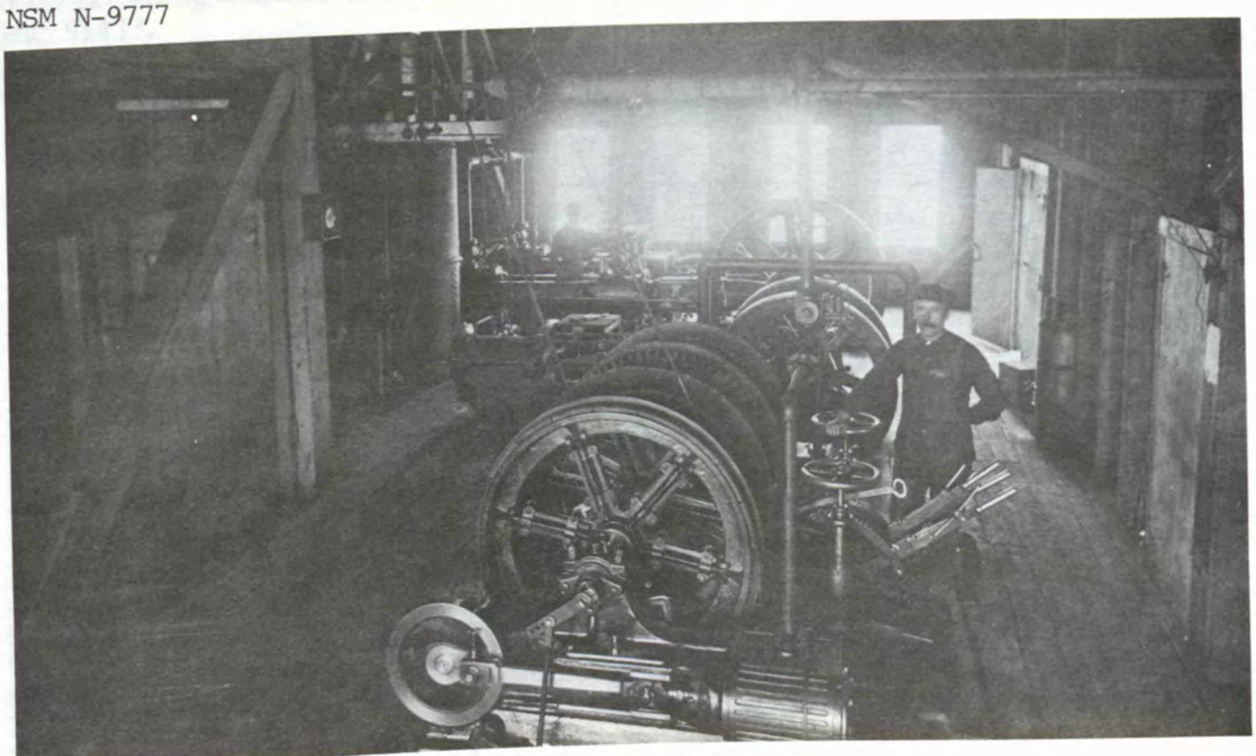
ILLUS. 38 - Unidentified tunnel. NSM N-2650.



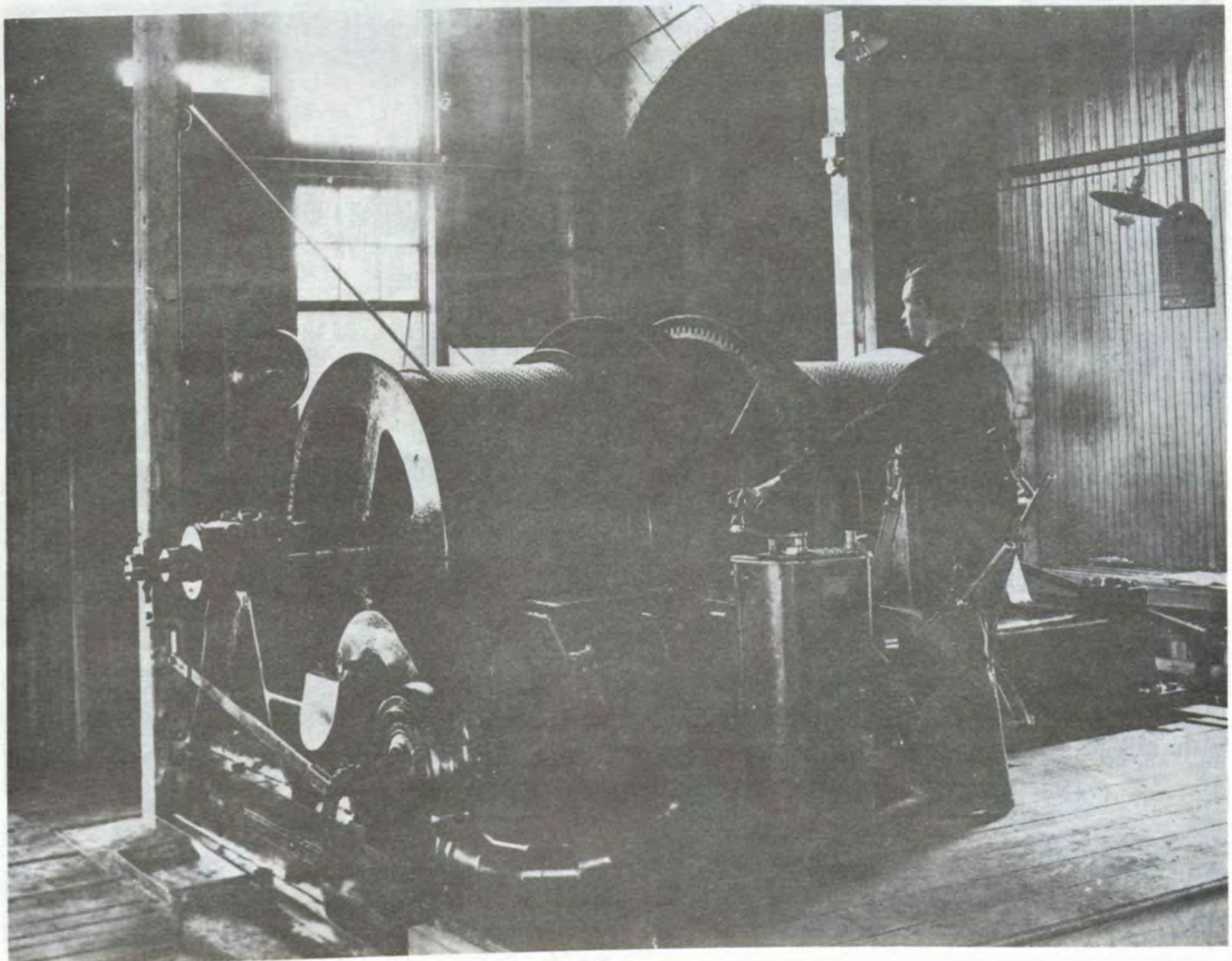
ILLUS. 39 - Hoisting Engine, Lidgerwood Manufacturing Company. Advertisement in Canadian Mining Manual, 1890-91. NSM N-10445.



ILLUS. 40 - Blue Nose Gold Mining Co. Ltd.
Hoisting engine and pumping engine.
NSM N-9777

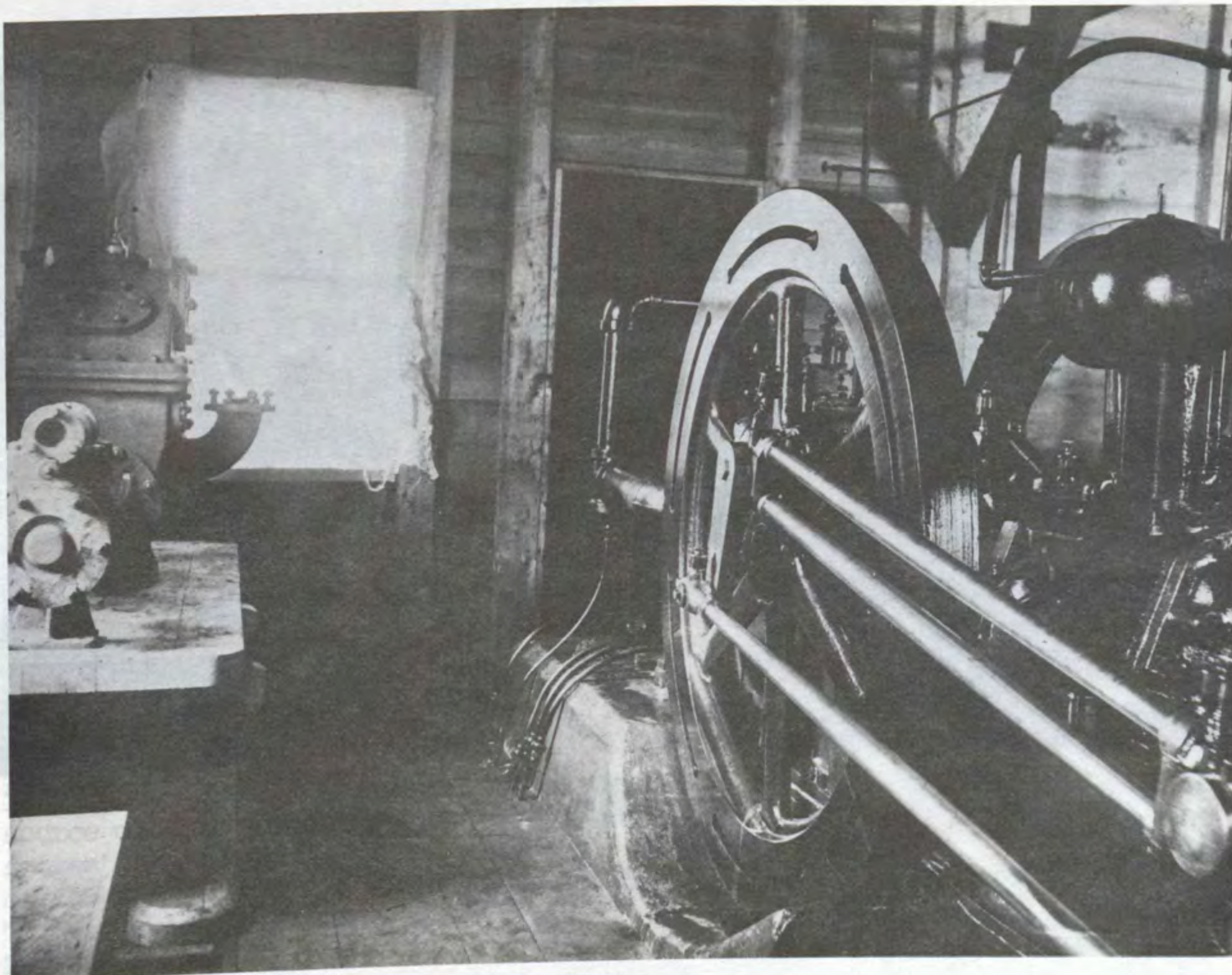


ILLUS. 41 - Baltimore and Nova Scotia Mining
Co., hoisting engine, Dolliver Mines.
NSM N-9778.



ILLUS. 42 - Engine house, interior. Lidgerwood hoisting engine, Dolliver Mines.
PAC 51437.

ILLUS. 43 - Working with hand steel.
Richardson's Face, East Tunnel in Canadian Mining Manual, 1899. NSM N-10429.



ILLUS. 44 - Compressor, Blue Nose Gold Mining Co., Goldenville, circa 1902. NSM N-5191.

ILLUS. 45 - Cross-cutting South, New Egerton Gold Mining Company, Fifteen Mile Stream, using early air drill, 1897. Candle-power provided the light. PAC 39894.

ILLUS. 46 - Candles continued to be the main source of illumination in the drifts and stopes of Goldenville during the first decade of the 1900s. This is underground at the Torquay Gold Mine, Moose River, 1897. PAC 39879.

ILLUS. 47 - Shaft house at Crow's Nest Gold Mine, 1897. PAC 39849.

ILLUS. 46 - Candles continued to be the main source of illumination in the drifts and stopes of Goldenville during the first decade of the 1900s. This is underground at the Torquay Gold Mine, Moose River, 1897. PAC 39879.

ILLUS. 47 - Shaft house at Crow's Nest Gold Mine, 1897. PAC 39849.

ILLUS. 48 - New Glasgow Gold Mining Co., Goldenville, 1897, looking east. Shaft houses. PAC 39882.

TIONS IN THE MILLING OF GOLD ORES-XI. GRASS VALLEY, CALIFORNIA.

Written for the Engineering and Mining Journal by T. A. Rickard.

(Continued from page 486.)

concluding this description of the mills of Grass Valley it will be draw attention to one or two matters of detail.

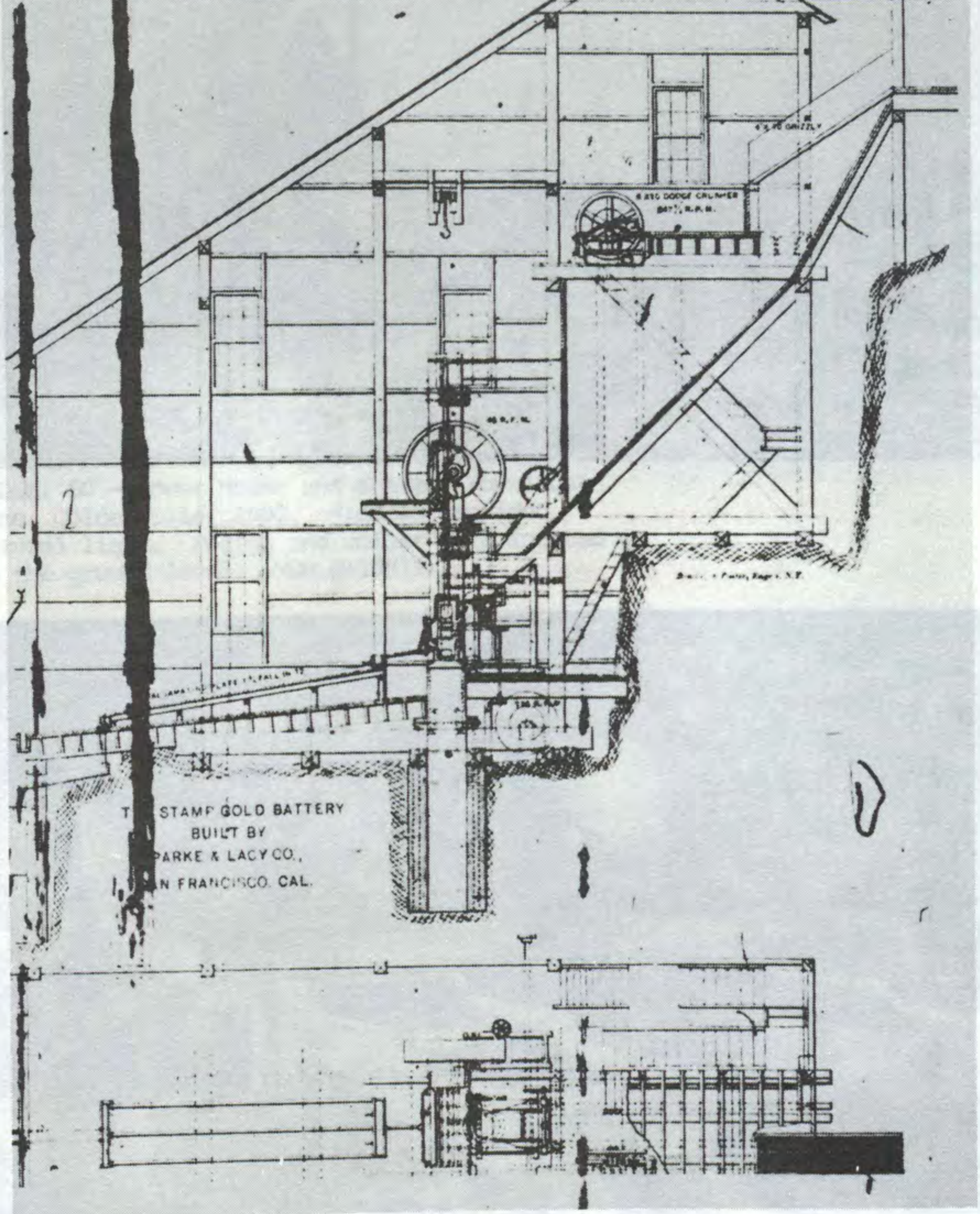
DEPTH OF DISCHARGE.

North Star there is no serious effort made to maintain a uniform depth of discharge. This is a mistake. A certain depth of dis-

that excessive depth of discharge which occurs when dies are allo wear down to the bitter end, and consequently seriously dimini crushing capacity of the battery.

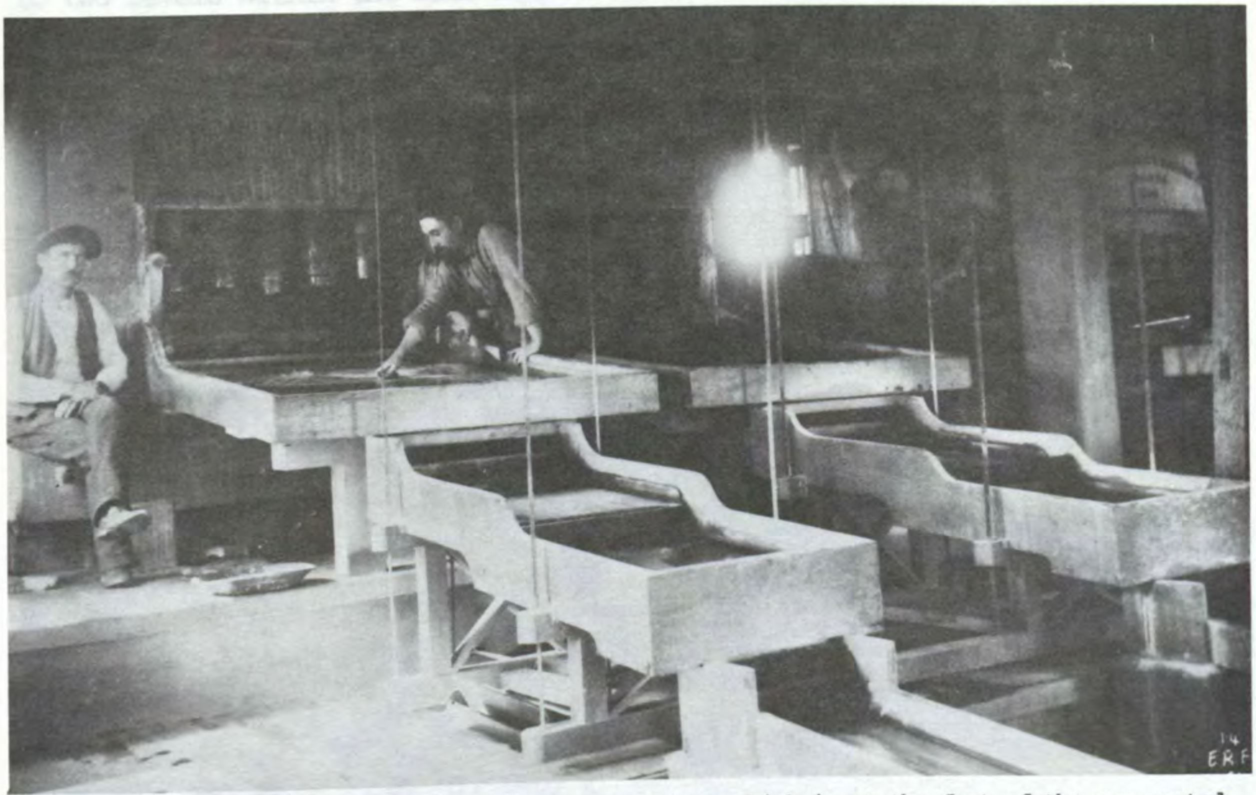
SCREENS.

In the matter of screens the millmen of Grass Valley have t retrograde step. The adoption of round punched tin plate scr

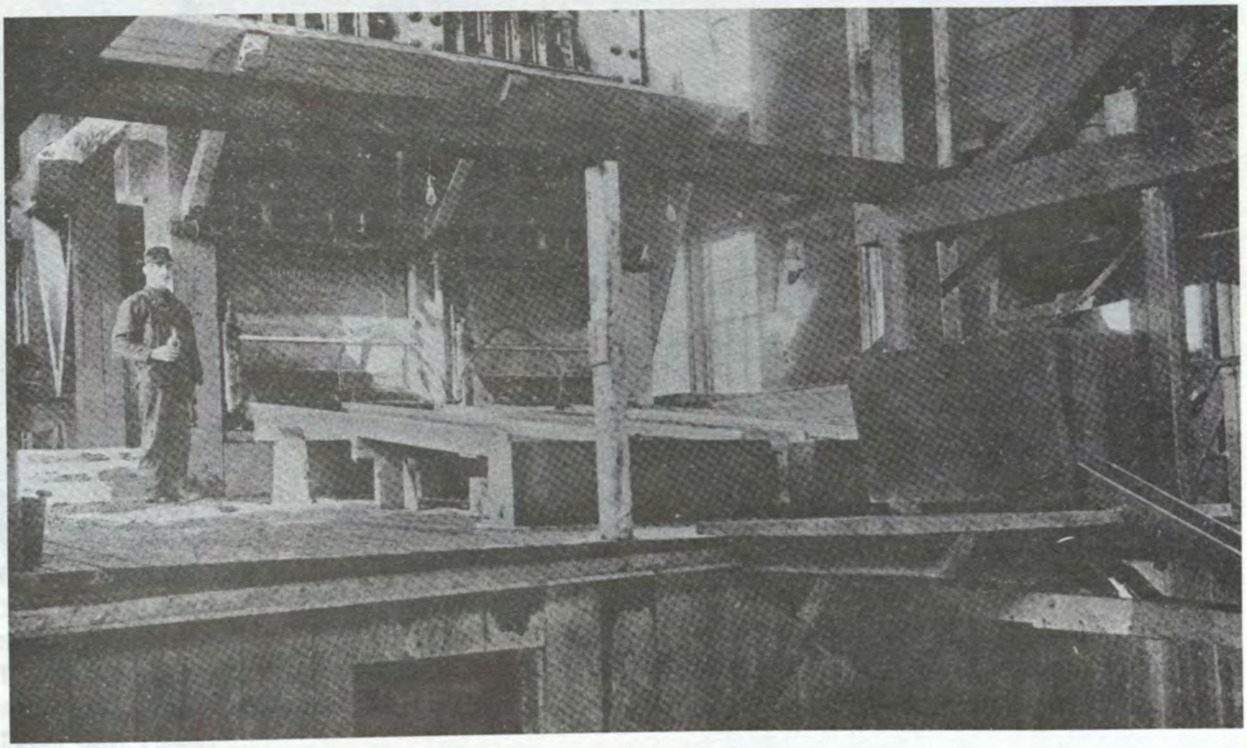


ILLUS. 49 - Plan of a stamp mill, 1893, as illustrated in Engineering and Mining Journal, v. 58, n.22, p. 511. The structure had to be at least three stories in height to accommodate all the necessary equipment and to use a gravity-feed system. This plan shows the arrangement of the concentrator vis-à-vis the stamp battery and tables. See page 96 of this report.

ILLUS. 50 - Power house and shaft. Royal Oak Mine, Goldenville, 1902. Windows provided natural light. Engine and boiler were located on the ground level. NSM N-10519.



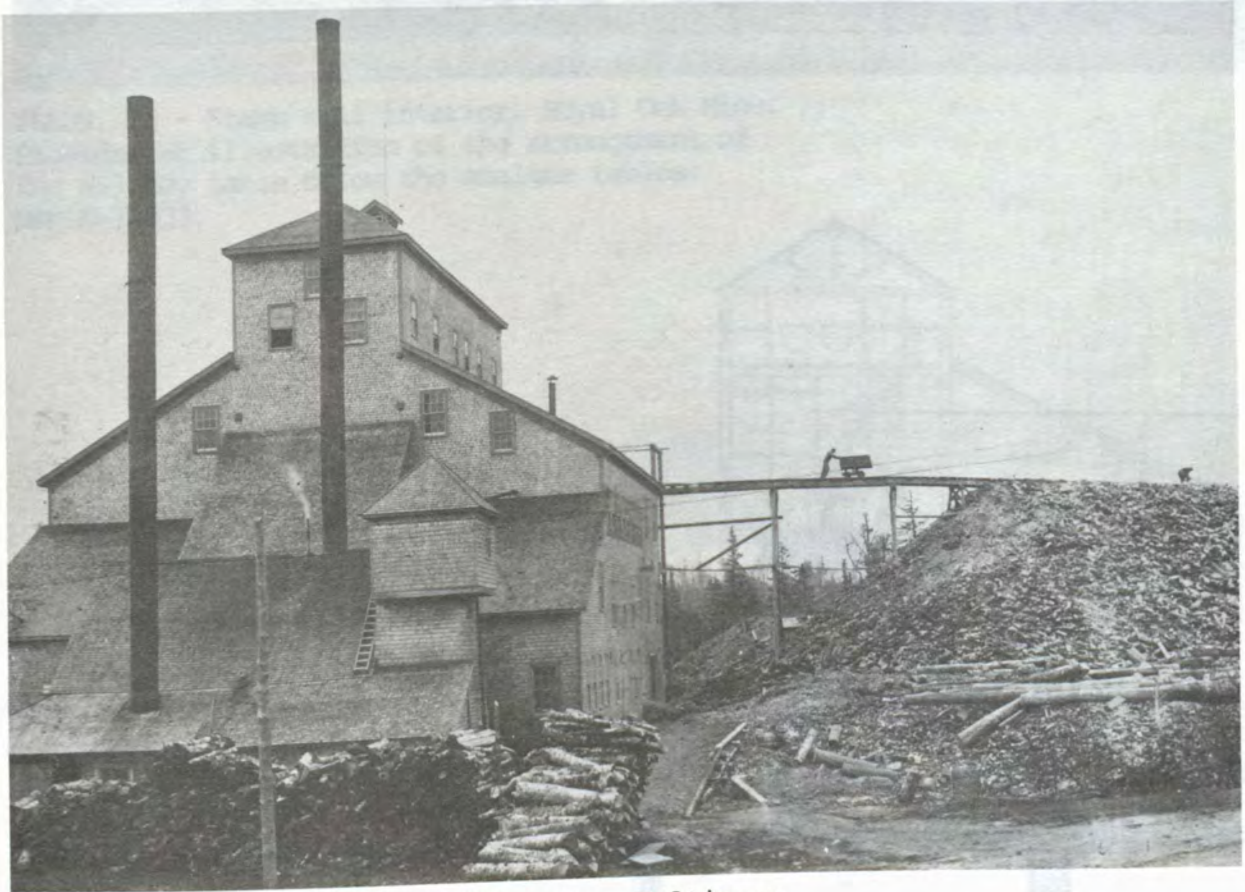
ILLUS. 51 - Cleaning up at the twenty-stamp mill, Dufferin Gold Mine, Salmon River, Hfx. Co., 1891. PAC 39829. Kerosene lamps provided some light. The mill man is scraping loose any amalgam which adhered to the table. Next it would be scraped into the amalgam plate which is at the feet of the man seated on the left. See reference to cleaning up on page 91 of this report. Shaking tables have been installed below the amalgam table to catch and treat tailings. See page 96 of this report.



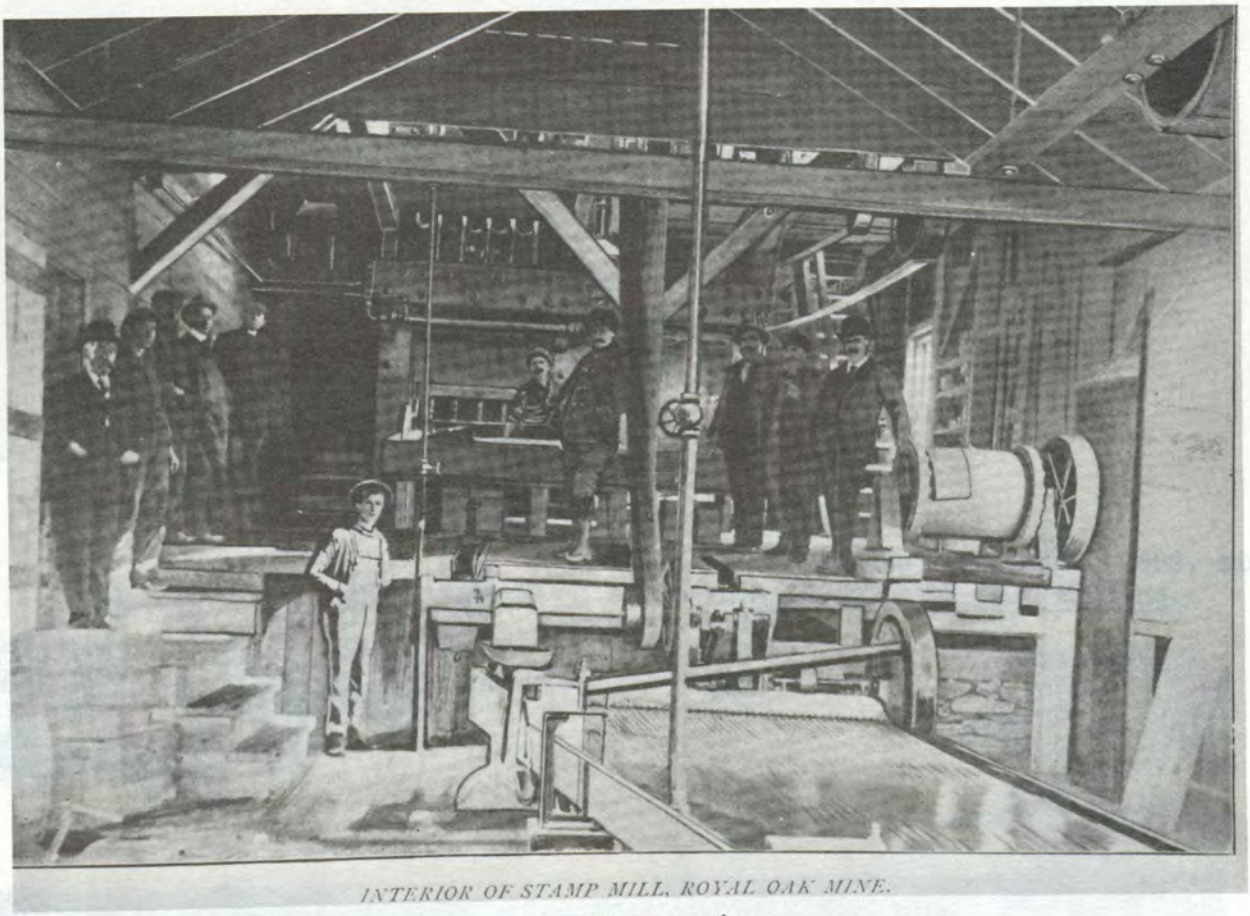
ILLUS. 52 - Lake Lode Mill, Caribou, 1897, as shown in The Canadian Mining Manual, 1897. A system of skylights provided natural light to two levels within the mill house. Note the plank flooring. NSM N-10432.

ILLUS. 53 - Harrigan Gold Mine, 1893. Mill building. PAC 39830.

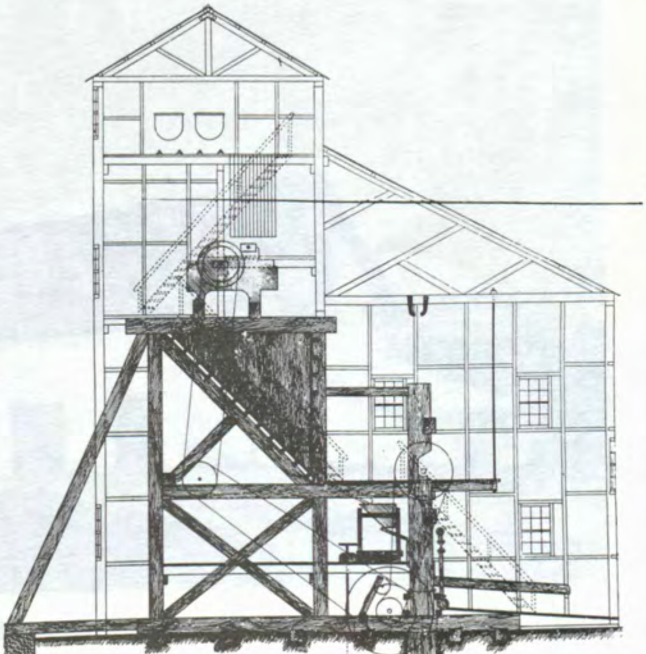
ILLUS. 54 - Shaft house and mill. Baltimore and N.S. Mining Co., circa 1904. NSM N-9780. The power source is housed at ground level also at some distance, if not separately, from the mill.



ILLUS 55 - Shaft house and mill, etc., Baltimore and Nova Scotian Mining Co., Caribou, Halifax Co., N.S., circa 1904. Smokestacks indicate that the boilers and engine were housed separately from the mill. NSM N-9781.



ILLUS. 56 - Stamp mill interior, Royal Oak Mine. Provides an illustration of the arrangement of the Wilfley table below the amalgam tables. NSM N-10433.



ILLUS. 57 - Plan for a stamp mill, as shown in figure 69, H. Louis, A Handbook of Gold Milling, London, MacMillan and Co. Ltd., 1899, second edition. NSM N-11430.

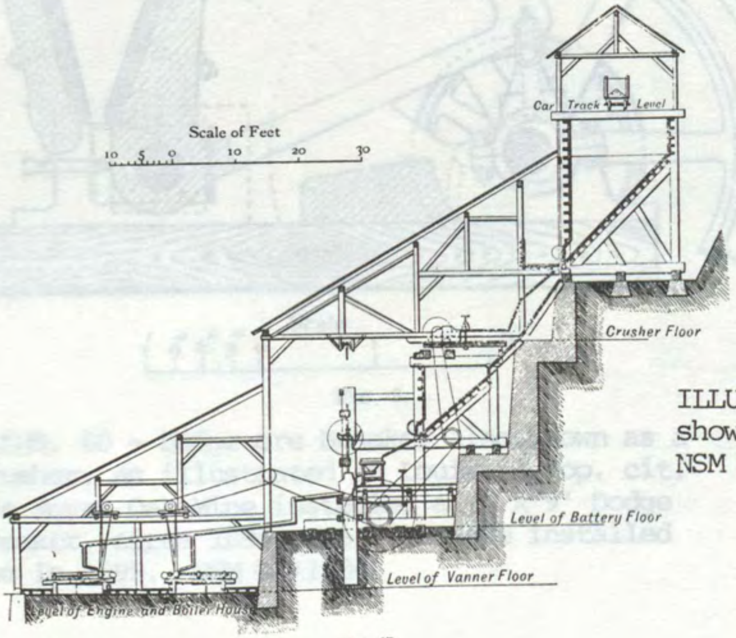
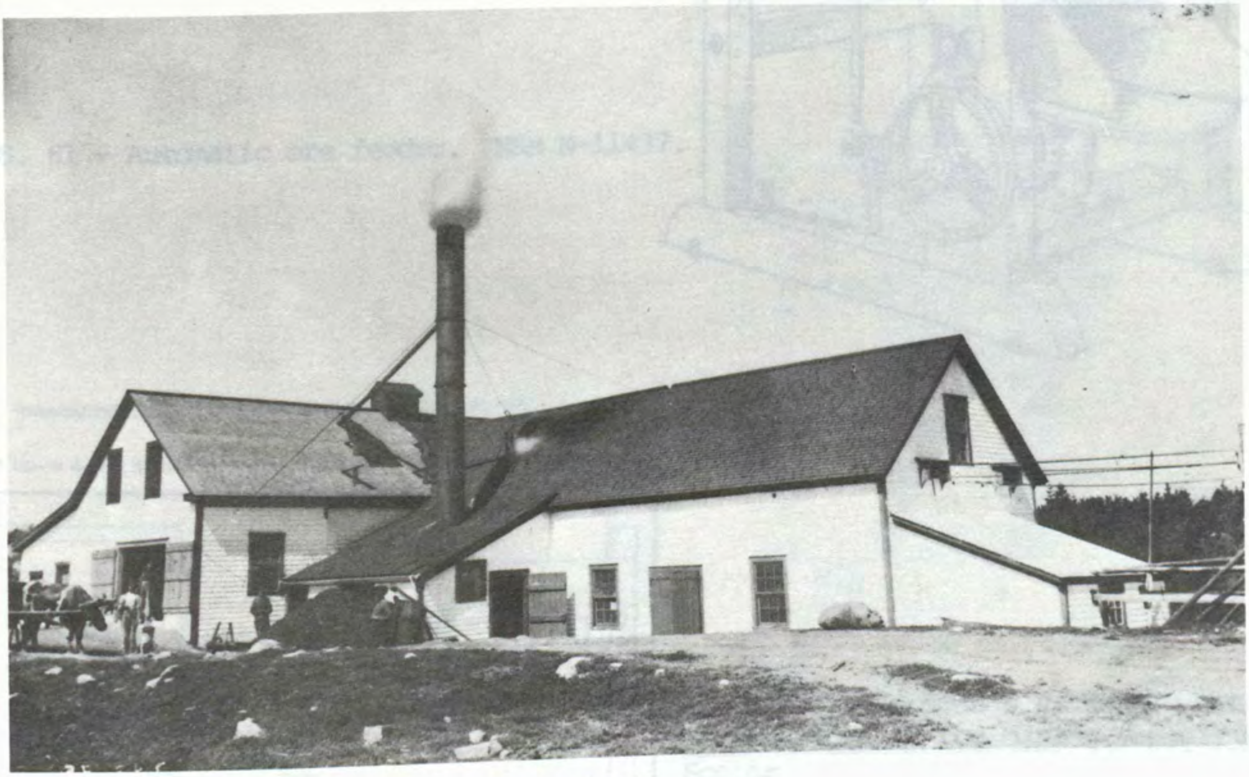


FIG. 67.

ILLUS. 58 - Plan, a stamp mill, 1899, also shown in A Handbook of Gold Milling. NSM N-11427.



ILLUS. 59 - Stamp mill, with power shed, Montague, 1891. PAC 39839.

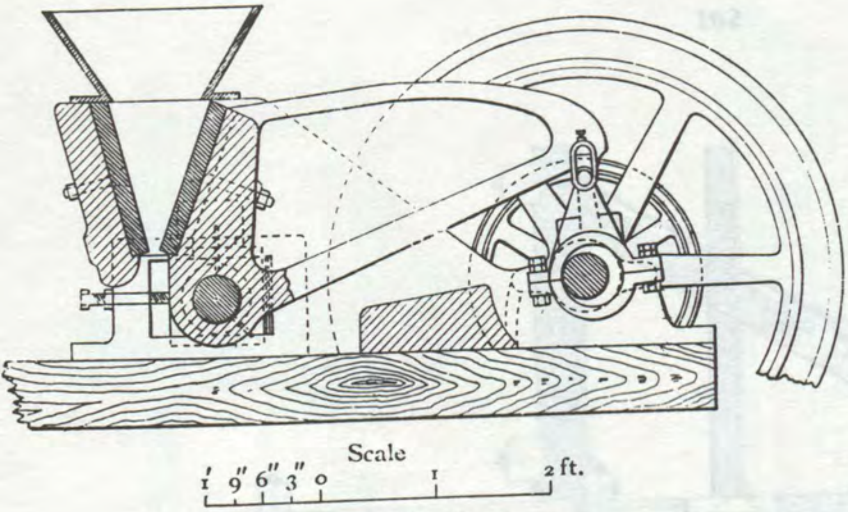


FIG. 3.

ILLUS. 60 - Dodge ore breaker also known as a crusher, as illustrated in Louis, H. op. cit. The Royal Oak Mine installed a 7' x 9' Dodge breaker, circa 1899; the Blue Nose installed one in 1898. NSM N-11434.

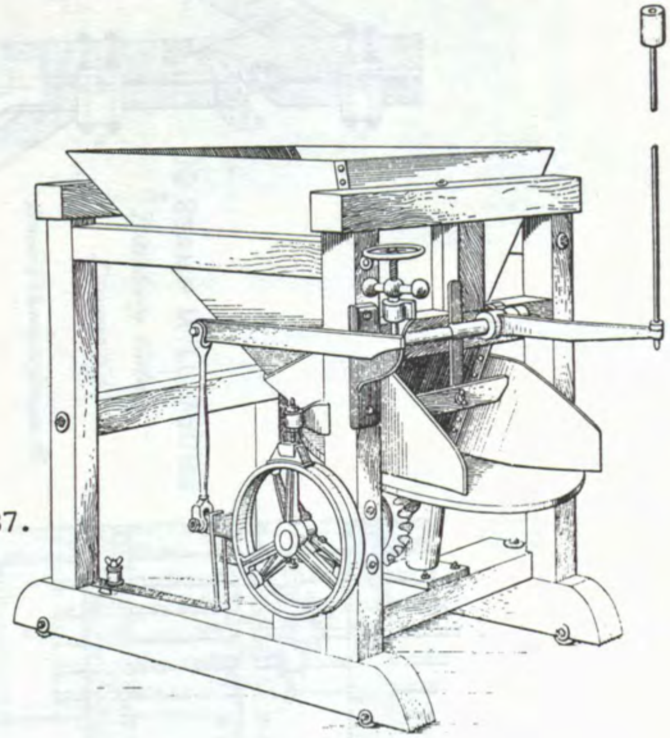
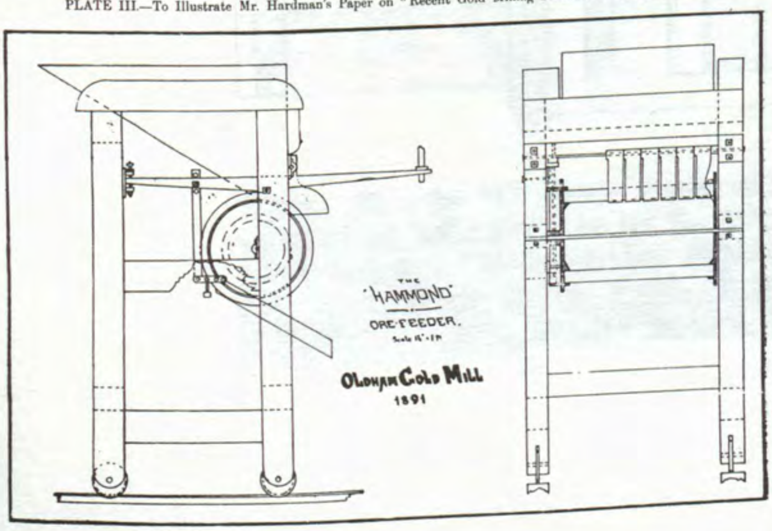


FIG. 73.

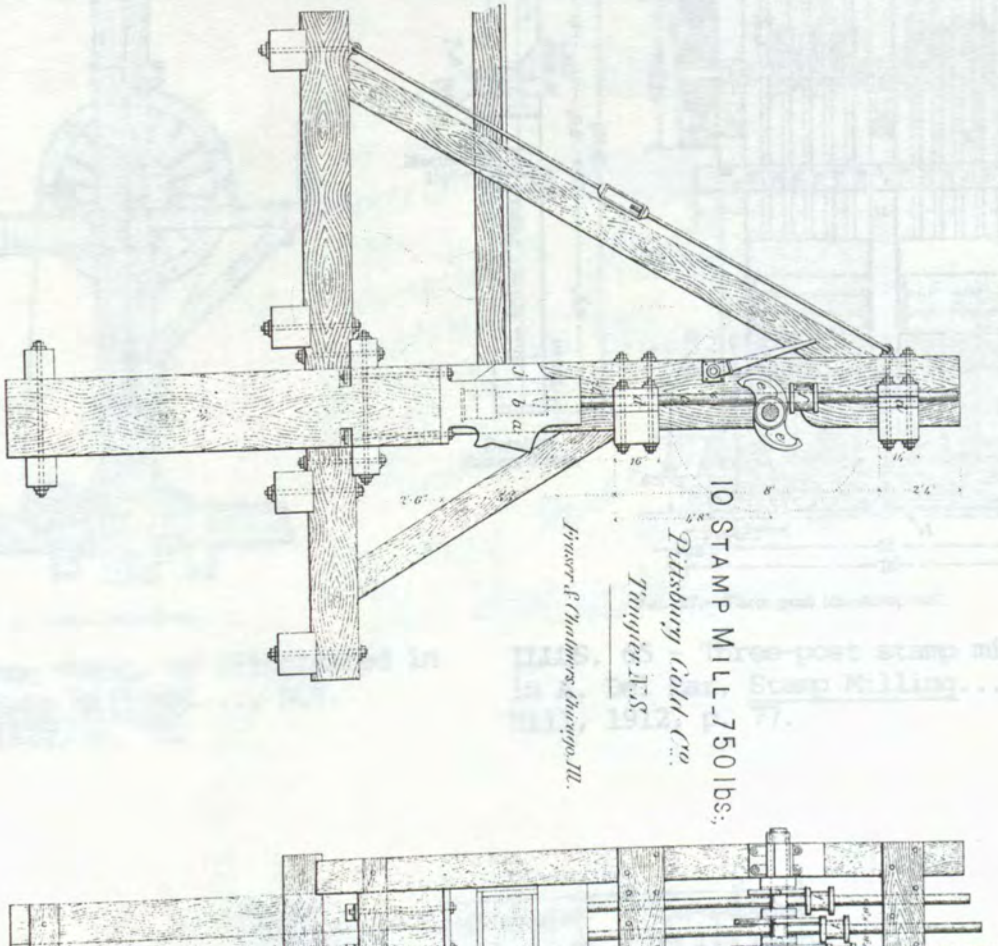
ILLUS. 61 - Automatic ore feeder. NSM N-11437.

TRANSACTIONS OF THE MINING SOCIETY OF NOVA SCOTIA.

PLATE III.—To Illustrate Mr. Hardman's Paper on "Recent Gold Milling Practice in Nova Scotia.



ILLUS. 62 - Hardman's automatic ore feeder in <u>Transactions of the Mining Society of Nova Scotia</u>



ILLUS. 63 - An "A" frame stamp mill, illustrating an 1882 article by E. Gilpin about stamp mills in Nova Scotia, published in The Proceedings of the North of England Institute of Mining and Mechanical Engineers.

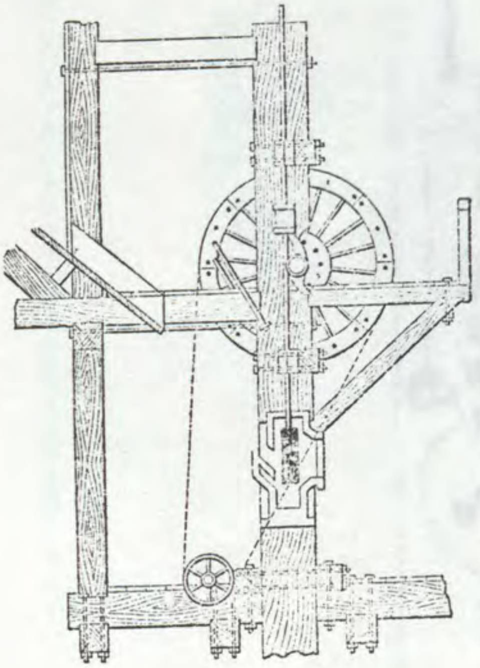


FIG. 22.—Back knee frame.

ILLUS. 64 - Knee frame, as illustrated in A. Del Mar, Stamp Milling...., N.Y. McGraw-Hill, 1912, p. 73.

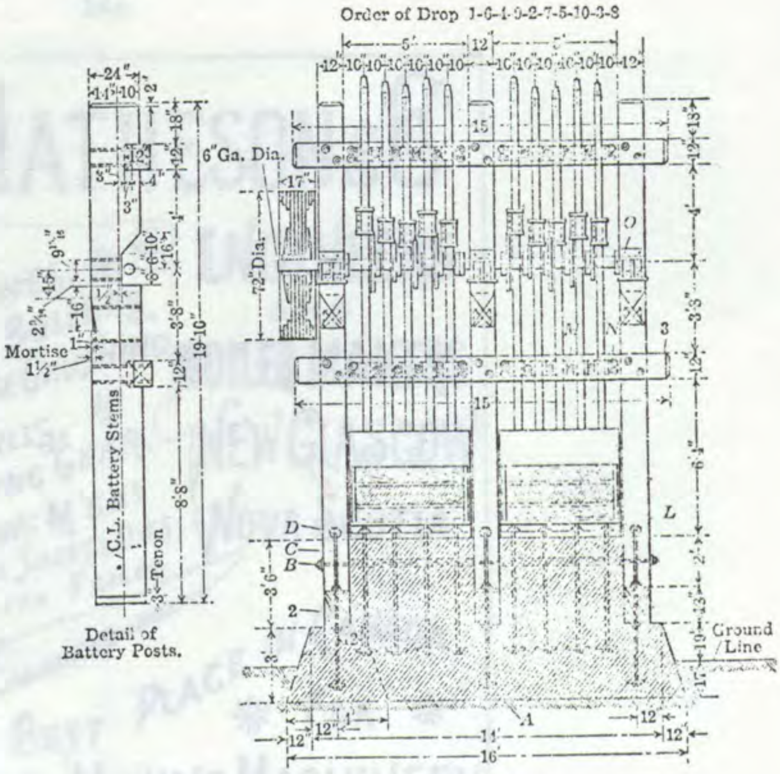


FIG. 27.—Three post ten-stamp mill.

ILLUS. 65 - Three-post stamp mill, illustrated in A. Del Mar, Stamp Milling...., N.Y. McGraw-Hill, 1912, p. 77.

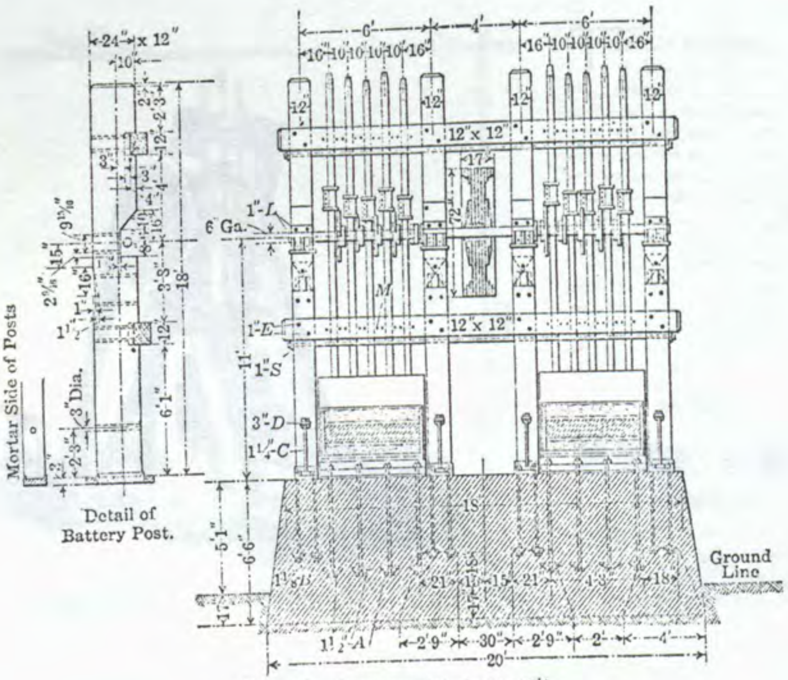
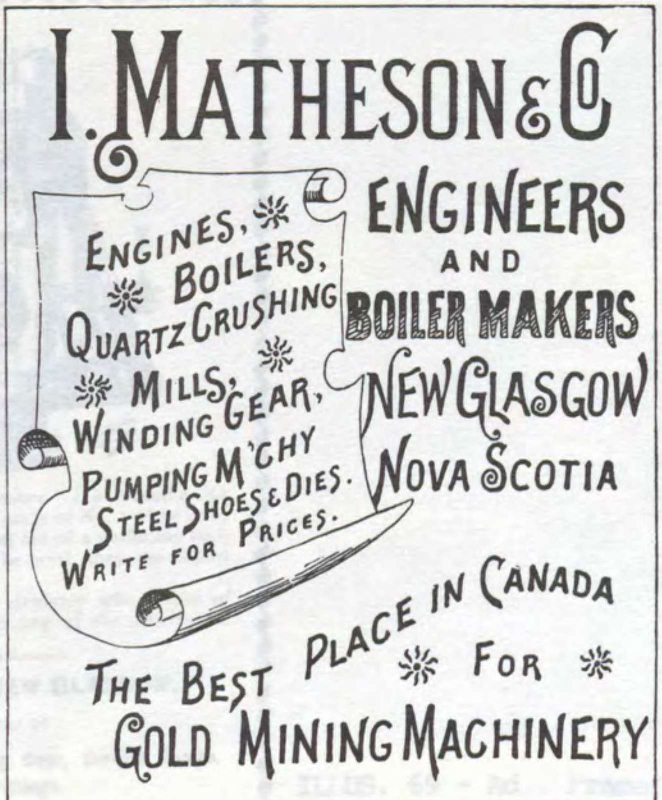
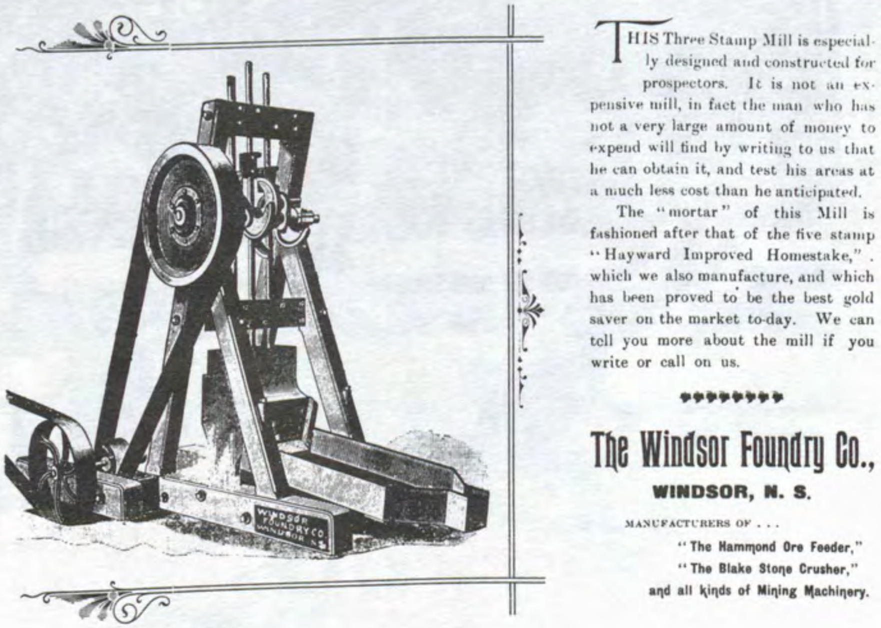


FIG. 28.—Four post ten-stamp unit.

ILLUS. 66 - Four-post stamp mill, Del Mar, p.78

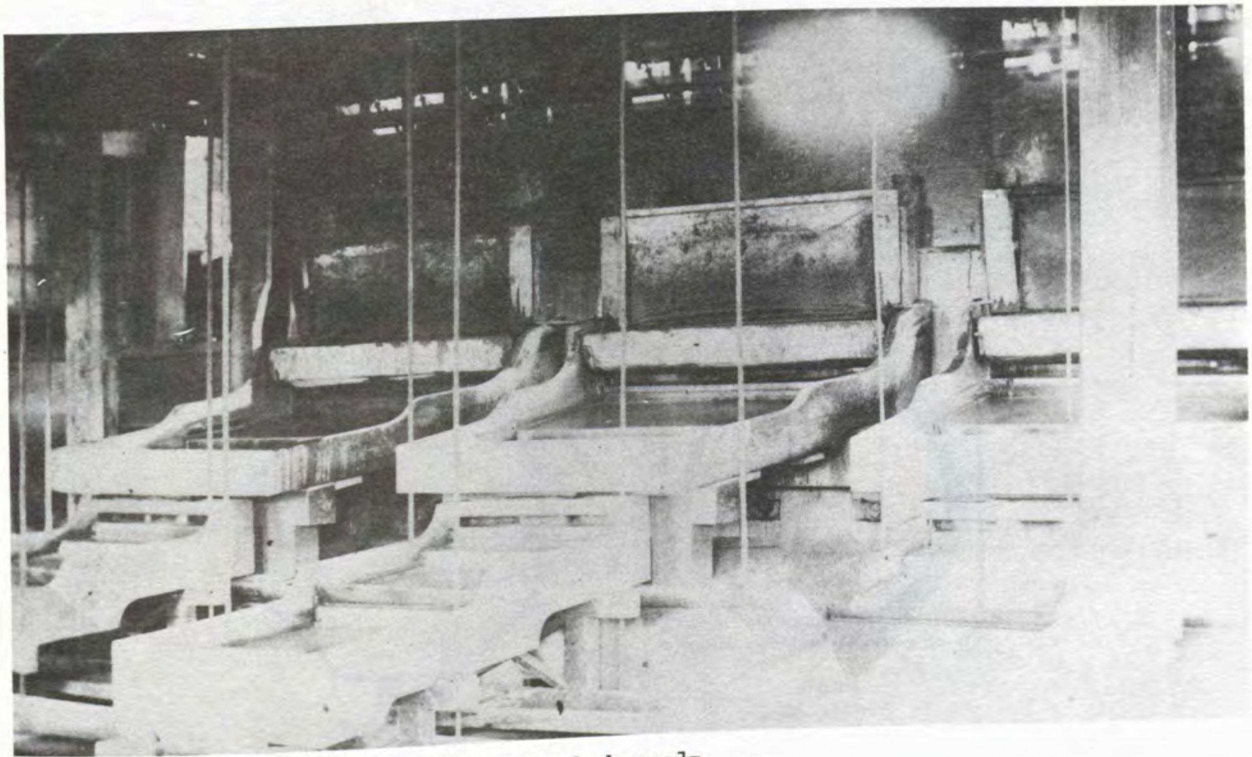


ILLUS. 67 - Advertisement, I. Matheson & Co., New Glasgow in Canadian Mining Manual, 1890-1891. NSM N-10434.

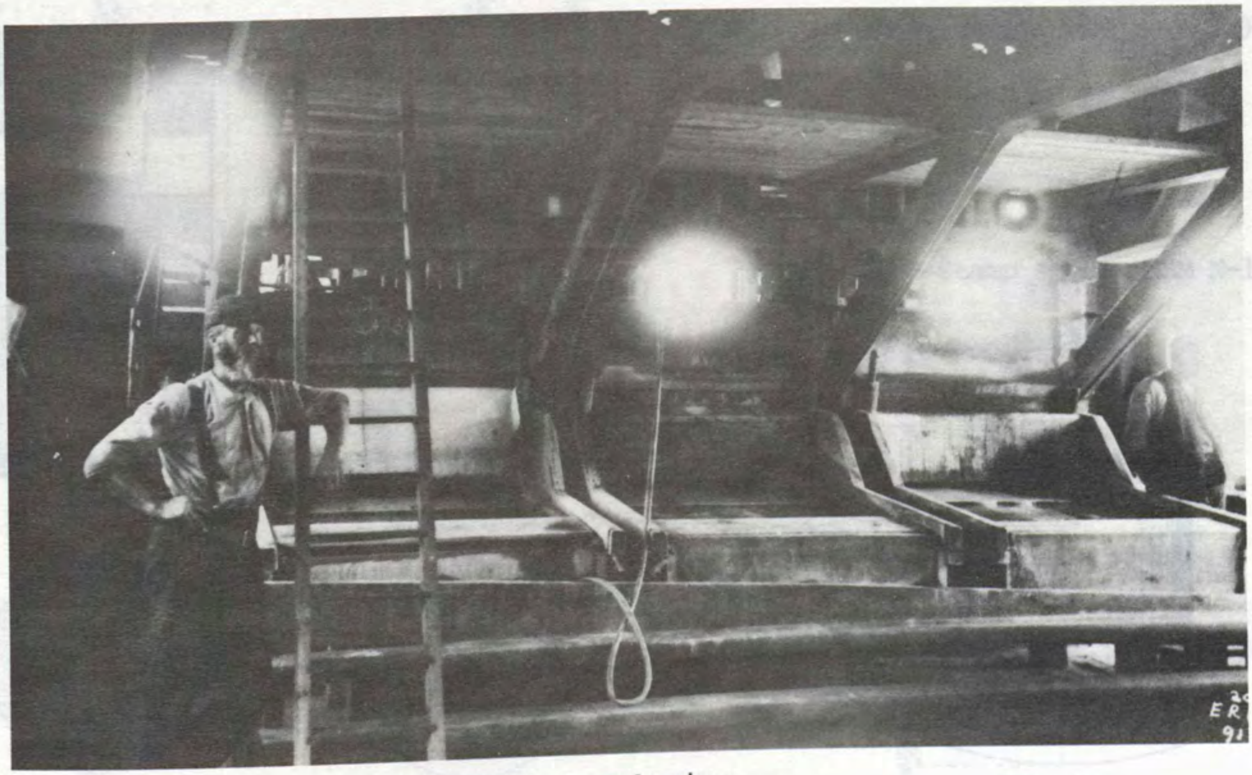


ILLUS. 68 - Advertisement. Windsor Foundry, in Industrial Advocate, II:2, 1897, p. 1. NSM N-10436.

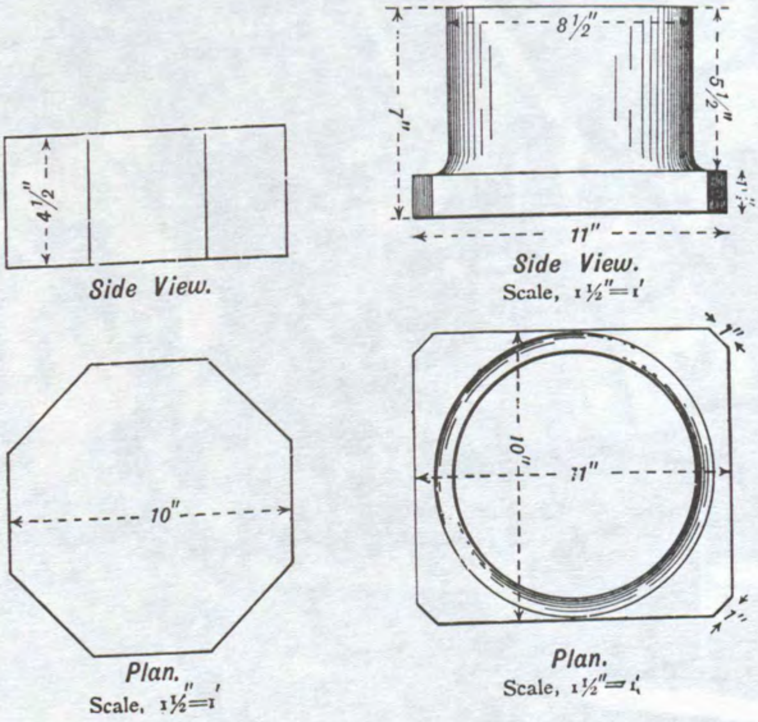
ILLUS. 69 - Ad., Fraser Bros., New Glasgow, in Industrial Advocate, II:I, 1897, p. 1. NSM N-10435.



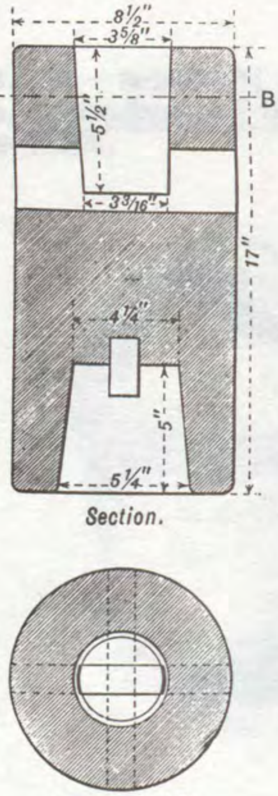
ILLUS. 70 - Screen frames and splash boards in the Egerton Stamp Mill at 15 Mile Stream. Batteries made by I. Matheson and Co., New Glasgow. PAC 51422.



ILLUS. 71 - Stamp mill, 3 batteries, Lakeview Gold Mining Co., Waverley, 1891. PAC 39858.

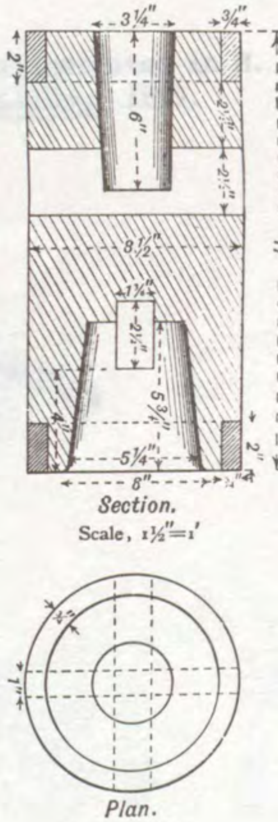


ILLUS. 72 - The most common shape of die used in the late 1800s. NSM N-11441.



Scale, 1½"=1'

FIG. 28.

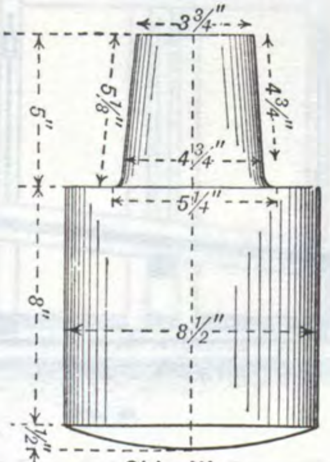


Scale, 1½"=1'

FIG. 29.

ILLUS. 73 - Stamp head. NSM N-11429.

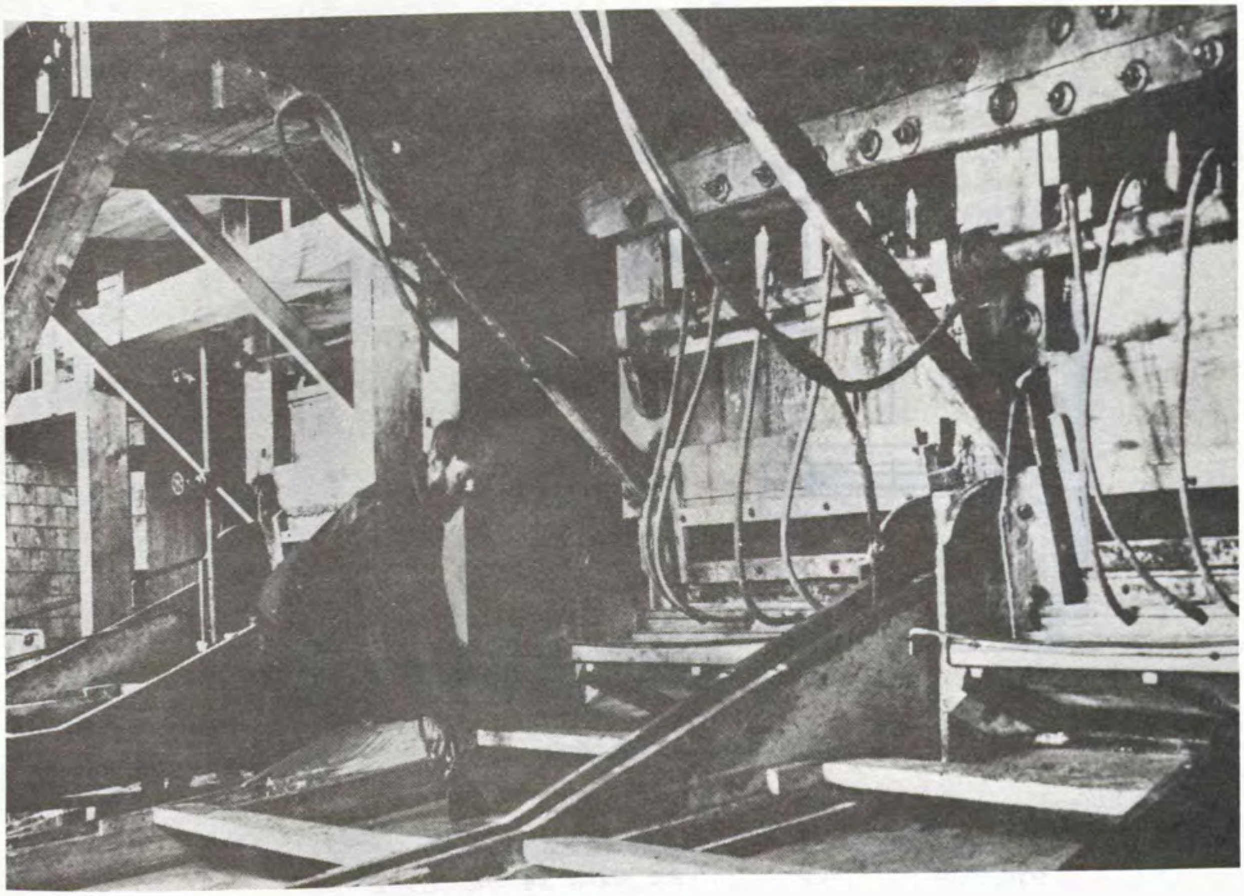
ILLUS. 74 - Stamp shoe. NSM N-11432.



Side View.

Scale, 1½"=1'

FIG. 30.



ILLUS. 75 - Battery clean-up. Stamp mill, MicMac Property in Report of Mining and Metalurgical Industries, 1907-08. NSM N-10437.

ILLUS. 76 - Retorting pot, illustrated in H. Louis, A Handbook of Gold Milling, 1899. NSM N-11436.

FIG. 114.

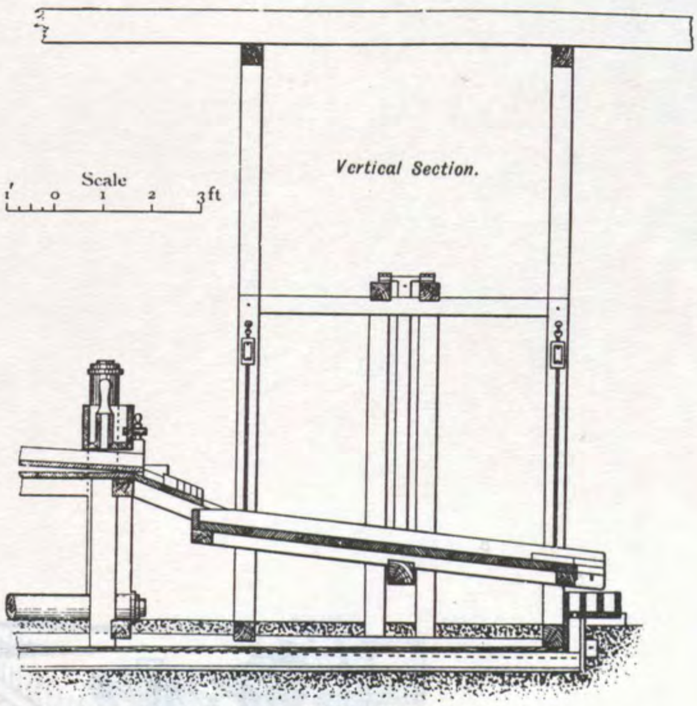


FIG. 89.

ILLUS. 77 - Shaking table as described by H. Louis, page 97 this report. See also endnote 73. NSM N-11428.

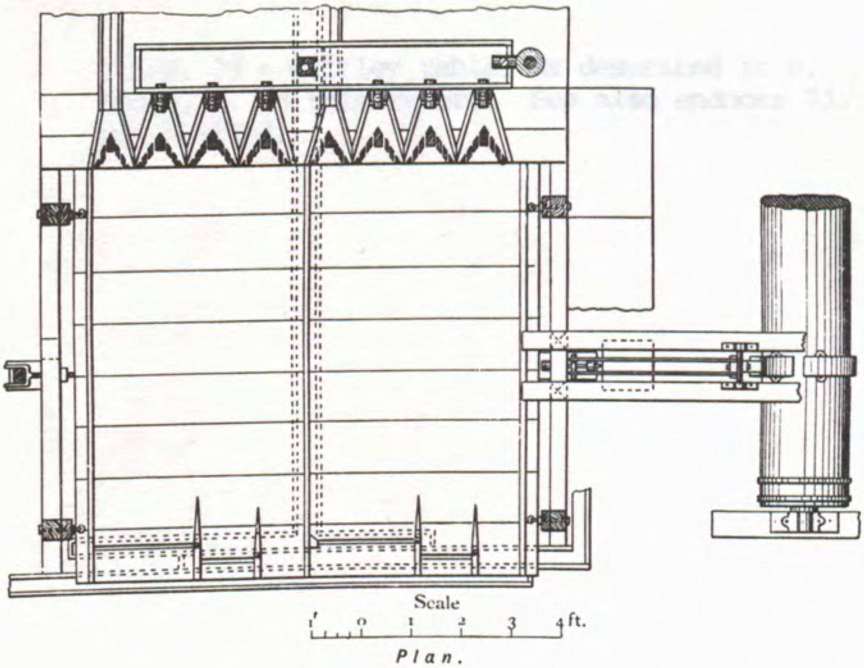


FIG. 90

ILLUS. 78 - Shaking table, as described by H. Louis, p. 97 this report. See also endnote 73. NSM N-11435.

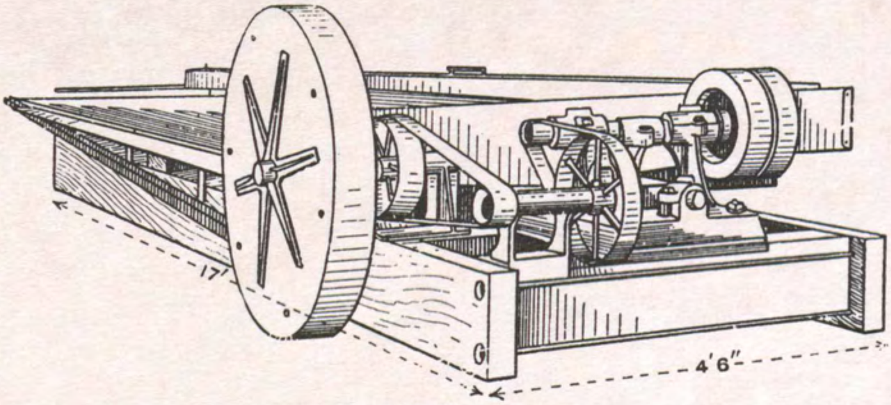


FIG. 94.

ILLUS. 79 - Wilfley table, as described in H. Louis, p. 98 this report. See also endnote 73. NSM N-11433.