

FOVA 32
Furnishings plan for Blacksmith
Shop 1982

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FURNISHINGS PLAN FOR BLACKSMITH SHOP

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FORT VANCOUVER NATIONAL HISTORIC SITE
VANCOUVER, WASHINGTON

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I. INTRODUCTION

A furnishings plan by definition "determines what furnishings to display and how to arrange them within an historic structure in an effort to re-create an environment for a person, event or place for a particular period of time".¹

Specifically, this plan undertakes the task of such a recreation for the reconstructed 1845 Blacksmith Shop at Fort Vancouver National Historic Site.

Located on the north bank of the Columbia River, 100 miles from the mouth and just east of the confluence of the Willamette and Columbia Rivers, Fort Vancouver was established in 1824-1825 by Dr. John McLoughlin, as the headquarters for the Hudson Bay Company's Columbia Department. In that capacity, Fort Vancouver acted as the principal supply depot and administrative center for the inland company posts and as a repository prior to their annual shipment to England for furs gathered in the Columbia Department.

In addition to the fur trade functions, Fort Vancouver cultivated many of its own crops, raised its own livestock, milled lumber at its sawmill, and ground grain into flour for daily use and export and made iron tools

1. Manual for Museums, R. H. Lewis. National Park Service, United States Department of Interior, Washington, D.C. 1976. P. 189.

and implements.

For much of its existence from 1825-1860, Fort Vancouver was nearly self-sufficient in the production and use of daily necessities.

The time frame selection for the furnishing and interpretation of the blacksmith shop by the National Park Service is significant. The year 1845 marks the beginning of a substantial decline in the economic importance of Fort Vancouver to the Hudson Bay Company's fur trade operations and its related activities and a gradual but definite shift to a retail and wholesale outlet for the Portland-Willamette Valley areas that had been settled by American emigrants in the 1840's and 1850's and, later, for those American settlers north of the Columbia River.

The blacksmith shop of 1845, when furnished, will represent one of the most important industrial and economic functions that was carried on at Fort Vancouver.

The blacksmith shop was absolutely essential to the conduct of the fur trade since the company was in constant need of iron axe heads, beaver traps and trap parts, hinges and hardware, bolts and metal objects for the company ships.

Visitors should be able to see and understand through the display of blacksmithing tools, forges, bellows and even more importantly, through

the presence of a demonstrating blacksmith, the vital importance of the blacksmith shop to the daily operations of Fort Vancouver.

Visitors should also be able to see and understand the related activities including tinsmithing, coopering, horseshoeing, gunsmithing and wheelwrighting that were also essential to the daily operations and were carried on by the blacksmiths and their assistants in the blacksmith shop in 1845.

II. ANALYSIS OF HISTORIC OCCUPANCY

History and Location

Since its first establishment in 1824-25, Fort Vancouver had a blacksmith shop. There apparently was some type of blacksmith shop at the original fort site which is now occupied by the Washington State School for the Deaf, approximately one mile northeast of the present reconstructed fort site.

A William Cannon or Canning was employed by the company as a blacksmith during these early years.

When the fort was moved to the river plain in 1829, a blacksmith shop was built inside the stockade. By 1845, the period to which the blacksmith shop and other structures inside the fort are being reconstructed and interpreted, the smithy had changed buildings and locations within the fort itself.²

The blacksmith shop was first recorded as a structure by the Wilkes Expedition of 1841. The Emmons ground plan of Fort Vancouver of July 25, 1841, shows the "blacksmith's shop---4 furnaces (forges)" located in the extreme southeast corner of the fort enclosure as it existed at that time.³

2. Historic Structures Report. Vol. II. Fort Vancouver National Historic Site. John A. Hussey, Denver Service Center. National Park Service, Dept. of Interior. April 1976, p. 193; hereafter cited as Hussey, Vol. II.

3. Hussey. Vol. II. p. 193

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The blacksmith shop had apparently been built between the time the stockade was enlarged to the east, about 1836 and 1841.⁴

According to George Emmons, this smithy was located directly east of the Missionary Store (Indian Trade Store) and southeast of Bachelors' Hall. Emmons showed the smithy as being close to the east and south stockade walls, with room for no other buildings in the southeastern corner of the fort. Yet, the two drawings of Fort Vancouver sketched by members of the Wilkes Expedition, one by Eld (Plate IV, Hussey, Vol. I.) and the other attributed to Agate (Plate LIII, Hussey, Vol. I.) clearly show two structures in the southeastern angle and east of the Indian Trade Store.⁵

The next available ground plan of Fort Vancouver, the so-called "Line of Fire" map drawn by Henry N. Peers shortly after the great fire of September, 1844, shows the blacksmith shop, though it is unidentified, in approximately the same location as shown by Emmons (see Plate V, Hussey, Vol. I). By 1844, the east stockade wall had been moved to the east approximately 56 feet from its position in 1841.⁶ Yet, the "Line of Fire" map shows no other building than the blacksmith shop between the Indian Trade Store and the southeast stockade corner. In other words, the two

4. Ibid. p. 194

5. Ibid. p. 194

6. Ibid. p. 194

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structures appearing in the Eld and Agate sketches were both not shown by Peers on his detailed and accurate, if extremely small-scaled, diagram.⁷

Not until the ground plan drawn by Lieutenant Vavasour of the Royal Navy, late in 1845, are the two structures shown in the extreme southeast corner on any known map of the fort. That plan places the "Smith's Shop" on about the same spot as did Emmons, and directly east of it is a second building identified as the "Iron Store" (see Plates VI-VIII, Hussey, Vol. I). In shape, their longer walls ran north and south. They correspond well with the two buildings shown in the southeast corner by the Eld and Agate sketches, but both the Emmons and the "Line of Fire" maps appear to indicate that only one of those structures, the blacksmith shop, existed prior to 1845.⁸

Thus, the question of why the two 1841 sketches showed two structures in the southeast corner of the fort is brought no nearer to solution by later date. There is still another problem. According to Hussey, it is probable, but not absolutely certain, that the blacksmith shop of 1845 was the same structure as that (No. 10) shown on the Emmons map.⁹ The sizes of the buildings appear to be similar but the locations, in relation

7. Ibid. p. 194

8. Hussey. Vol. II. p. 194

9. Ibid. p. 194

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to Bachelor's Hall and the south palisade, are slightly different.

According to Hussey, the discrepancies were due to the conditions under which Emmons was forced to prepare his plan. The blacksmith shop of 1841 was the same building as that plotted by Vavasour.¹⁰ The location of this blacksmith shop, which was that of the 1845-46 period chosen by the National Park Service for reconstruction, is today identified as Building No. 22 on the site plan of Fort Vancouver National Historic Site.¹¹

According to Hussey, one other question connected with the history of the blacksmith shop also remains unanswered. Lieutenant Vavasour's fellow officer, Henry J. Warre, kept a journal while he was at Fort Vancouver during the winter of 1845-46, and from it he later wrote a narrative in which he said, "*Within the stockade were several dwelling houses, a kitchen, oven, blacksmith's house and shop, and cooperage*".¹²

This is a definite statement that at least one of the fort's blacksmiths lived inside the stockade, either in a separate building or in quarters that were part of the blacksmith shop.¹³ According to Hussey, no supporting evidence for Warre's assertion has been found.¹³ The uses of

10. Ibid. p. 194.

11. Ibid. p. 194.

12. Hussey. Vol. II. p. 195.

13. Ibid. p. 194

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all the structures inside the fort were reasonably well recorded, and no quarters for blacksmiths are mentioned. Also, a blacksmith shop containing four forges would have been a crowded, noisy, dirty place, hardly a desirable location for private quarters, even if they were in a garret. The blacksmith shop inventories list no items associated with domestic use.¹⁴

There does remain the possibility, however, that one or more of the blacksmiths could have lived in a loft over the adjoining Iron Store. This location would have been more suitable, and this hypothesis may be reasonable since numerous domestic items were recovered, archaeologically, from the Iron Store area.¹⁵

The archaeological report on the southeastern area of the fort (Vol. X) has made three interpretations based upon the recovered artifacts as to the nature of the occupancy of the blacksmith shop--structural, industrial and domestic. Large amounts of partial and complete iron tools and implements were found, definitely indicating use of Building No. 22 as a blacksmith shop.

14. Ibid. p. 195.

15. Hussey. P. 195 and Archaeological Report, Vol. X. p. 291.

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Large amounts of material culture remains were found archaeologically on the site of Building No. 22 indicating that the building may have had some type of domestic use after 1845. The blacksmith shop was standing when United States Army officers inventoried the fort's buildings on June 15, 1860 and reported the blacksmith shop in a ruinous condition.¹⁶

Material culture remains found on the site of the blacksmith shop include ceramic and household container fragments, common pottery, majolica and earthenware, ale bottles, blacking bottles, Canton (Chinese) ginger jars, pipe fragments, buttons and tumbler and stemware glass fragments.¹⁷

According to the interpretations in the Archaeological Report, it can be assumed that someone at sometime was living in the blacksmith shop. Perhaps space was available in a loft or garret after the blacksmith shop had been abandoned as a smithy in 1850 (see Hussey. Vol. I, p. 336).

In any event, for the purposes of this Plan, the National Park Service drawings do not provide a loft or any other space to be utilized for interpreting domestic activities in the reconstructed blacksmith shop.

16. Archaeological Report. Vol. X. p. 28.

17. See Fort Vancouver Excavations, Southeastern Fort Area. Ross, 1975. Pps. 56-83 for a complete presentation of the archaeological evidence on material culture remaining of the blacksmith shop site.

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Blacksmith Shop History Operations

The blacksmith shop was an essential economic and industrial feature of the fort's daily operations. It is reasonable to state that the entire complex at Fort Vancouver could not have long existed without the services of the blacksmith. The smithy was so important that the fort had two blacksmith shops in the 1840's.

The various blacksmiths working for the Hudson Bay Company at Fort Vancouver were engaged in two principal economic and industrial functions. One; smiths worked at repairing company property and manufacturing essential metal items used in construction, transportation and agriculture. Two; smiths were employed commercially to produce beaver traps, axe heads, agricultural, and thin iron and tin wares. Most smithing functions, as practiced by company employees, would have been regarded as light to medium ironworking. Items commonly repaired or manufactured included; weaponry, domestic articles, building hardware, hand tools, agricultural implements, wagon parts, animal shoes, boat hardware and cartage hardware.¹⁸

Occasionally, more extensive repairs or manufactured items were undertaken including cable chains, ship hardware, steam machinery, saw mill

18. Archaeological Report, 1829-1860. Lester Ross, National Park Service, 1976. Vol. VI. p. 1147.

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and grist mill hardware and parts.

In conclusion, repairs for most metal items would not have been beyond the capabilities of the company blacksmiths at Fort Vancouver, but articles as large as a ship's anchor would have proved to be a serious challenge mainly because of size.

Most smithing tools were "country made" by the blacksmiths themselves, but as with other "country made" items, were seldom listed on the Fort Vancouver inventories.¹⁹

According to Henry Spaulding, the American missionary, who visited Fort Vancouver in the fall of 1836, with the Whitman party, "there were eight or ten blacksmiths constantly at work" at the fort.²⁰ In October 1838, James Douglas told the London directors of the Hudson Bay Company that there were nine "tradesmen and others" engaged at the "Forge".²¹ Because the employee rolls for Outfit 1838 listed only four blacksmiths under the headings "Fort Vancouver Depot" and "General Charges", it can be reasonably assumed that the remaining five men at the blacksmith shop were largely ordinary laborers or voyageurs assigned to assist the regular blacksmiths in their tasks.²²

19. Archaeological Report. Vol. X. p. 1152.

20. Hussey. Vol. II. p. 196.

21. Ibid. p. 196.

22. Ibid. p. 196.

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This condition apparently still prevailed during 1845-1848, the period of immediate consideration for the purposes of this Plan. Clerk George B. Roberts, though failing to specify any date, seems to have been speaking of the mid-1840's when he later said that there were eight men in the blacksmith shop.²³ It is obvious that these four skilled artisans, whose annual salaries ranged from 30 to 35 pounds, were being assisted by approximately four "middle-men" or laborers.²⁵ How these eight or more workmen were distributed between the fort's two blacksmith shops is not recorded.²⁶

There exists a better description of the second blacksmith shop which was located approximately six miles upstream at the sawmill, than there does of the blacksmith shop inside the stockade. In 1841, Lieutenant Charles Wilkes visited the sawmill, which he later described in his narrative.

"They have a large smith's shop here, which, besides doing the work of the mill, makes all the axes and hatchets used by the trappers. The iron and steel are imported: the tools are manufactured at a much less price than those imported, and are more to be depended on. A trapper's success, in fact, depends upon his axe; and on this being lost or broken, he necessari-

23. Ibid. p. 196.

24. Ibid. p. 196.

25. Ibid. p. 196.

26. Ibid. p. 196.

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ly relinquishes his labours, and returns unsuccessful. Fifty of them, it is said, can be manufactured in a day, and twenty-five are accounted an ordinary day's work. They are eagerly sought after by the Indians, who are very particular that the axe should have a certain shape, somewhat like a tomahawk." ²⁷

According to Hussey, Wilkes was in error when he stated that "all" the axes and hatchets used by the trappers were made at the sawmill forge, at least if Wilkes meant to imply that all the hatchets used in the Indian trade were manufactured at that site.²⁸

Narcissa Whitman, in 1836, reported that the fort's blacksmiths were "all" employed in making the agricultural implements needed for the missions to be established by the American Board of Commissioners for Foreign Missions.²⁹

A visitor, during the 1840's, found that the agricultural implements available at Fort Vancouver were "very reasonable" and that the "best Cary ploughs can be had to order from an excellent blacksmith at the place at 31 1/4 cents per pound".³⁰

27. Wilkes Narrative, p. 336 as quoted by Hussey. Vol. II. p. 197

28. Hussey. Vol. II. p. 197.

29. Hussey. Vol. II. p. 198.

30. Ibid. p. 198.

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It should be noted that not all the beaver traps, trap parts, nails, hardware, ploughs and other iron and steel objects used by the company in its Columbia Department operations or sold in its stores were made at Fort Vancouver.³¹ Requisitions and inventories definitely indicate that large quantities of finished iron and steel stock were imported from England along with the sheet and bar metal from which to manufacture many of the same articles locally.³² Also, there were blacksmith shops at other principal posts throughout the Columbia and on the Northwest Coast.³³

Whether the various iron and steel articles were ordered from England or were "country made" appears to have depended, in large part, upon comparative costs. For example, when making out the Columbia District requisition for Outfit 1846, Dr. McLoughlin, on March 20, 1843, included a request for "50 beaver traps with springs", explaining, "We have ordered 50 of these traps with springs on trial, and, if the springs answer our purpose and are cheaper than we can make them here, we shall order all we require from England".³⁴

Occasionally, the operations of the fort's blacksmith shops became a matter of general concern on the part of the company's upper management. Import-

31. Ibid. p. 198.

32. Ibid. p. 198.

33. Ibid. p. 198.

34. Ibid. p. 198.

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ing coal from England for use in the Columbia Department's forges was expensive because it was bulky and occupied space that might have been devoted to more profitable trade goods.³⁵ In 1839 the London directors informed McLoughlin that they intended to send "no Coals" in 1841 and, apparently, urged the Columbia Department's chief factor to locate another source of coal for the forges.³⁶ In desperation, McLoughlin answered the directors on November 20, 1840, pointing out that the coal found on Vancouver Island and on the Cowlitz River had already been tried and was of poor quality. McLoughlin, in 1826-27, had made charcoal from the available local woods but said it would not do the job.³⁷ "You will see the absolute necessity there is that you send us coals by the Vessel to sail from Lond in 1841", he urged, "as I need not state the ruinous consequences which will result if we are deprived of Coals to manufacture &c. the Iron Works for the Trade."³⁸

The Governor and Committee of the Hudson Bay Company relented and agreed to continue the coal shipments in 1841 and 1842, but they informed McLoughlin that they were inclined to think he had not made his charcoal correctly, "as the best iron of Sweden and Norway is produced and worked by charcoal made from fir".³⁹ Apparently, Governor George Simpson may have

35. Hussey. Vol. II. p. 199.

36. Ibid. p. 199.

37. Ibid. p. 199.

38. Ibid. p. 199.

39. Hussey. Vol. II. p. 199

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shared this view, because while he was at Sitka late in 1841, he arranged for the Russian American Fur Company to send two charcoal burners to Fort Vancouver for a year to instruct "our people" in the correct method of making charcoal.⁴⁰ One Russian actually reached Fort Vancouver in the spring of 1842, but McLoughlin reported, seemingly with some scorn, that the visitor's efforts had been unsuccessful because he had found "the wood of this place does not answer to make Coals so well as that at Sitika (sic)" and that it would cost as much to manufacture unsatisfactory charcoal at Fort Vancouver as to import good quality coal from England.⁴¹

According to Hussey, the experiment with making charcoal in the Columbia Department was discontinued and shipments of coal from England resumed.⁴² It is not known if woods other than fir were experimented with in making charcoal. Local hardwood such as maple, white oak, ash or alder grew near the fort and would have been readily available for use in the manufacture of charcoal.

The last blacksmith to be listed as such on the Fort Vancouver rolls was David Smith, who served during Outfit 1852. By the summer of 1857, Chief Factor Dugald Mactavish, then in charge of Fort Vancouver, had to advise

40. Hussey. Vol. II. p. 199.

41. Ibid. p. 199.

42. Ibid. p. 199.

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William Fraser Tolmie at Fort Nisqually to acquire his beaver traps from Fort Victoria. "I have had some springs made but they are not the thing", he added. "There are, in fact, few blacksmiths in the Country who understand how to temper them".⁴³ Apparently, the company personnel south of the 49th parallel had been reduced to shopping around among the nearby American blacksmiths for beaver traps.

Fort Vancouver Blacksmiths, 1845-1846

The Columbia Department personnel rolls for Outfit 1845 list only four blacksmiths at Fort Vancouver. They were George Aitken, Joseph Ovide Beauchamp, George Folster and Thomas Scott.⁴⁴ George Aitken appears to have been the chief blacksmith, if salaries were any indication. He received 35 pounds per year, whereas the other three blacksmiths received only 30 pounds. Aitken had served the company for about ten years by 1845.⁴⁵

Joseph Ovide Beauchamp had only been in the company's service three years in 1845. He could write, or at least sign his name. On May 12, 1845, he married Margherita (Marguerita) Decheste (of the Shastas) at Fort Vancouver in a ceremony conducted by Father Jean Nobili, Society of Jesuits.⁴⁶ Mar-

43. Hussey. Vol. II. p. 200.

44. Hussey. Vol. II. p. 200.

45. Ibid. p. 200.

46. Ibid. p. 200.

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guerite died on December 17, 1847, "aged about 20 years".⁴⁷

George Folster, the second of his name in the company's service, was a veteran with the company by 1845, having been employed approximately sixteen years. He first appeared on the Fort Vancouver rolls for Outfit 1830 at a salary of 30 pounds per year, and he evidently remained at the fort through Outfit 1832.⁴⁸ Apparently, he was then transferred to Fort McLoughlin on the Northwest Coast, because William Fraser Tolmie found "Foster" to be a blacksmith there early in 1834.⁴⁹ Tolmie described him as "an ingenious Orkneyman".⁵⁰ Back at Fort Vancouver during Outfit 1835, Folster apparently served well, for in 1838 his annual salary was increased to 40 pounds, a substantial raise for a tradesman. However, by Outfit 1842, his salary had been reduced to 20 pounds per year. By 1845, he had been raised to 30 pounds.⁵¹

There are a few details available on Folster's private life. On August 15, 1844, Father Modests Demers buried in the Fort Vancouver cemetery a woman named Helene, "aged about 24 years, having lived with George Folster".⁵² On March 20, 1847, Alexandre Dundass Folster, "natural son of George Folster and of Waskopam woman, aged 1 month," was baptised at Fort Vancouver.⁵³

47. Ibid. p. 200.

51. Ibid. p. 201.

48. Hussey. Vol. II. p. 201.

52. Ibid. p. 201.

49. Hussey. Vol. II. p. 201.

53. Ibid. p. 201.

50. Hussey. Vol. II. p. 201.

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On October 30, 1849, William, aged about two weeks, "son of George Folster and of Marguerite of the Dalles", was baptised. Folster died at Fort Vancouver in 1850.⁵⁴

54. Ibid. p. 201.

III. EVIDENCE OF ORIGINAL FURNISHINGS

Fortunately, the blacksmith shop is one of the buildings inside the fort to have a complete inventory of furnishings for 1845, the year to which this Plan calls for the blacksmith shop to be furnished and interpreted.

The inventory for 1844 lists 29 separate items in the blacksmith shop:

- 4 large Anvils
- 1 " Do old
- 3 pair Bellows
- 1 " Do old
- 1 Iron Brace
- 1 Bow w(it)h 6 drills and breastplate
- 1 Water Bucket
- 1 Pres(s)ure Drill
- 1/2 doz assd. Files
- 1 Grindstone
- 4 bench Hammers
- 8 hand Do
- 3 sledge Do
- 15 Axe Mandrills
- 20 " ass Do Punches
- 20 nail Moulds
- 1 truss hoop Mandrill
- 1 wheel of measurement
- 1 small screw Plate
- 1 Pan
- 2 fire Pokers
- 4 Rakes
- 1 Slate
- 4 fire Shovels
- 1 Coal Do
- 40 pairs assd. Tongs
- 1 set Tools for shoeing Horses
- 3 bench Vises
- 2 hand do bad 55

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The annual inventory taken during the spring of 1845 is considerably shorter than the previous year. A number of the items listed for 1844 still appear on the 1845 inventory. But a number of items of crucial importance to the operation of a blacksmith shop - a grindstone, pressure drills, and nail moulds - for example, are missing from the 1845 inventory.⁵⁶

The following is a list of items in the blacksmith shop in the spring of 1845:

- 4 sets Hammers
- 54 p Tongs
- 70 Punches
- 6 cold Chisels
- 6 Screw plates 2 5 Tops
- 6 Stock and dyes w 3 Do
- 20 Nail Borers
- 4 p Bellows
- 4 Anvils
- 3 bench Vises
- 3 sledge Hammers
- 2 hand Do
- 4 fire Shovels 57

Why there is such a discrepancy in the number of items between the 1844 and 1845 inventories cannot logically be explained or documented at this time. Perhaps, it can be hypothesized that a number of the items in the

56. Hussey. Vol. II. p. 209.

57. Hussey. Vol. II. pps. 209-210.

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blacksmith shop had, by 1845, been transferred to the smithy near the sawmill upriver from Fort Vancouver. Perhaps some of the items present on the 1844 inventory had, by 1845, been transferred to another post in the Columbia Department. A further explanation for the discrepancy could have been the simple error of the individual who took the inventory for the blacksmith shop for 1845. Perhaps, he was careless and omitted items that were in fact actually still in the blacksmith shop in 1845; perhaps errors were made in transcribing the inventories in the company's ledgers.⁵⁸

Another hypothesis for this discrepancy might be that the blacksmith operations were scaled down for Outfit 1845 due to an overall decrease in the fur trade for that outfit; even though the number of bellows and anvils, a total of four of each, were apparently in use or at least still in the shop. In any event, there are serious discrepancies in the inventories for 1844-45 that cannot be properly reconciled.

In the late 1840's there were additions and changes in the blacksmith shop inventories. By the spring of 1847, the blacksmith shop inventory had undergone considerable change. For one thing, according to Hussey, the presence of such items crucial to the operations of the shop - three anvils, three bellows, three fire shovels - could have indicated that

58. Telephone Interview with John Hussey by David K. Hansen. 6-20-80

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only three forges were operating that year.⁵⁹ The following is a list of items in the blacksmith shop in the spring of 1847:

- 3 Anvils
- 3 prs. Bellows
- 12 Nail Borers
- 15 Cold Chisels
- 2 Clinch Hammers
- 4 Setts Do
- 8 hand Do
- 3 sledge Do
- 13 Punches
- 3 fire Shovels
- 3 Pokers
- 2 Screw Plates complete
- 1 Stock & dyes complete
- 30 prs Tongs
- 3 Bench Vises
- 2 Stock Sheers (sic)
- 1 hand Saw
- 2 Rules Iron 60
- 1 Grindstone

Perhaps, by 1847, the demand for iron objects to support the fur trade - traps, trap parts, knives and axe heads- had diminished, thus lessening the work of the blacksmiths.

The inventory taken in the spring of 1848 is the most detailed of the four year period beginning in 1844:

- 4 Anvils
- 1 lge weighing Beam w wooden scales & weights

59. Hussey. Vol. II. p. 210.

60. Ibid. p. 210.

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3 prs large Bellows
20 Nail Borers
1 Brace & Bitts
2 prs Callipers
9 cold Chisels
3 blacksmiths rubber Files
6 assorted Files
2 clenck Hammers
9 hand Do
3 sets Do
3 sledge Do
1 large Grindstone
1 " Mandrill pr truss hoops
24 small Do
2 setts brass ball Moulds
2 screw Plates complete
3 Pokers
30 Punches
1 iron Rule
3 fire Shovels
2 iron Do
1 hand Saw
1 Saw Blade
2 prs stock Shears
1 Stock and Dyes complete
30 prs Tongs
3 bench Vises
1 hand Do
1 plated Steel square 61

Again, why there is a larger number of items on the 1848 inventory cannot be logically explained at this time. Both the 1847 and 1848 blacksmith shop inventories do serve to show the overall quantity and variety of tools used in an Hudson Bay Company blacksmith shop of the 1840's and are thus useful for comparative purposes against the 1845 inventory.

61. Hussey. Vol. II. p. 211.

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It is not known at this point what happened to the tools listed on the 1845-1848 blacksmith shop inventories after the smithy was abandoned by the company in 1852. Presumably, the tools and other furnishings of the shop would have been transferred to another post in the Columbia Department with a blacksmith shop, or to the headquarters at Fort Victoria. Those that were no longer useful, damaged or broken were apparently discarded as is indicated by the large numbers of tong pieces found archaeologically.

Other Furnishings

Although the historic inventories for 1845-1848 list only items that were apparently used in the manufacture and repair of metal tools and implements for everyday use, the archaeological evidence is very conclusive as to other types of furnishings that would have been present and in use in a Hudson Bay Company blacksmith shop of the 1845 period.

These other types of furnishings, which are described in detail in the archaeological Report, Vol. X, include thousands of partial and complete iron tools, implements and objects (see plates 24-39) which were recovered during the National Park Service archaeological excavations beginning in 1947.

The list of tools is almost endless, but includes such iron objects as

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chisels, punches, various trap parts, bolts, screws, nuts, nails, locks, hinges and latches, wedges, drill bits and tongs. All of these items were at one time made by the blacksmiths for daily use at Fort Vancouver and for the far-flung fur trade. Over a period of time, the items were apparently discarded or possibly left behind in the building after the company abandoned the smithy in 1852.

These recovered iron and metal objects are now in the park's archaeological study collection. These objects, in effect, constitute a rich "unlisted" inventory of original furnishings of the blacksmith shop that were produced on a daily basis.

This large collection of recovered objects cannot be ignored in describing the entire spectrum of furnishings in the blacksmith shop (for a complete description with illustrations, see Fort Vancouver Archaeological Report. Vol. X. 1975). These objects in one sense constitute a category of "original furnishings".

Other items, which, while not specifically listed on any of the historic inventories, can be documented with archaeological evidence and would have been needed to support any blacksmithing operations. Such furnishings and fixtures would have been work benches for the blacksmiths, tinsmiths and wheelwrights.

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The Archaeological Report, Vol. X gives a hypothetical reconstructed floor plan for the blacksmith shop, which is based on available historical evidence and in situ archaeological remains. This plan shows a series of work benches located on the east wall of the smithy.⁶² The National Park Service drawings for the reconstructed blacksmith shop specify a series of work benches on the east and west walls. See National Park Service drawings, Plate 16. Sixteen post and post holes were observed and identified by flat-based vertical wooden post remains or soil costs of the posts set in prepared holes. The archaeologists maintained that the posts could have been supports for tool benches, anvil bases or bellow supports. Benches would have held such stationary tools as bench vises and non-stationary tools such as hammers, punches, chisels, etc. These benches would have logically had some type of drawer arrangement in which to store various smaller tools when not in use. The interiors of the drawers would have been compartmentalized for insuring greater order in the storage of the tools. The National Park Service drawings for the blacksmith shop specify drawers to be installed in the work benches.

Hussey mentions that historically no coal box is listed on any inventory for the blacksmith shop. It would have been logical for the blacksmith shop to have had some type of coal box or receptacle to hold the fuel

62. Archaeological Report. Vol. X. p. 422. Figure 1243.

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for the forges. Historically and archaeologically, it is known that the smith used coal. The hypothetical drawing for the blacksmith shop shows two coal piles, one in the southwest corner of the shop and the other in the northeast corner.⁶³ The exact size of the coal piles is not known, but it can be assumed that they would have been rather sizeable since large quantities of coal were imported from England at one time for use in the smithy. Coal for daily use in the forges would probably have been brought into the shop in smaller amounts and put in the coal box or boxes.

The anvils that are listed on the inventories would have needed some type of base. Archaeologically, a number of post holes were observed which could have been bases for the four anvils.⁶⁴ The hypothetical drawing of the blacksmith shop shows three areas where possible anvil bases could have sat.⁶⁵ Possible bases for the four large bellows were also observed archaeologically.⁶⁶

Quenching pits where large iron items being manufactured were cooled, were also observed archaeologically.⁶⁷ All of these stationary fixtures can be considered as part of the original furnishings of the blacksmith shop.

63. Archaeological Report. Vol. X. p. 422, figure 243.

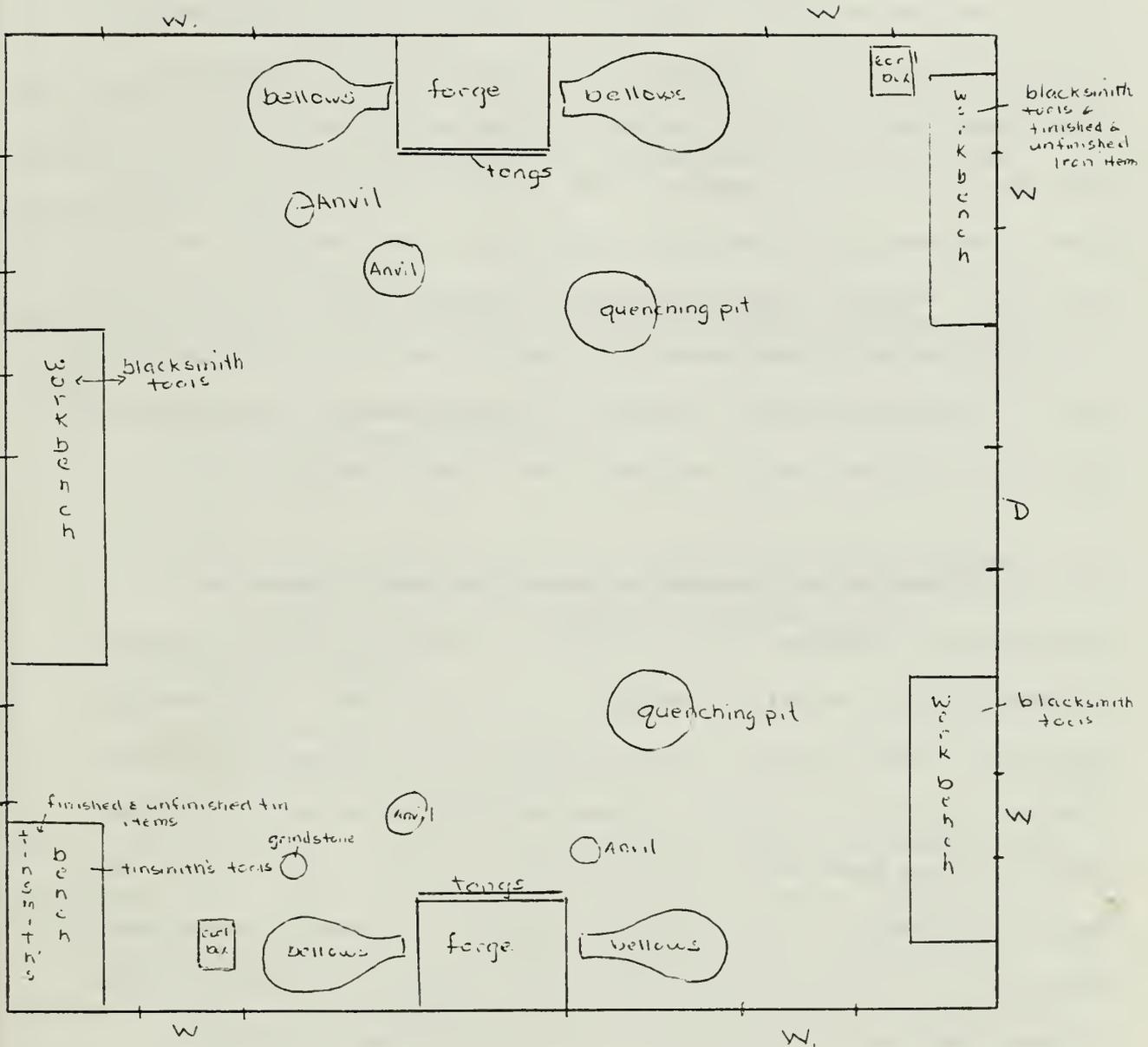
64. Archaeological Report. Vol. X. p. 34.

65. Ibid. p. 421. Figure 242.

66. Ibid. p. 421.

67. Ibid. p. 421, figure 242

Blacksmith Shop



IV. RECOMMENDED FURNISHINGS FOR THE BLACKSMITH SHOP

The reconstructed 1845 blacksmith shop will serve two functions; one, it will serve as an historic structure museum of a particular year and economic period and will display tools, furnishings and fixtures and other items associated with the various blacksmithing activities that were carried on in the blacksmith shop to demonstrate the vital importance of metalworking to the daily operations of Fort Vancouver and the fur trade. Secondly, the reconstructed blacksmith shop will function as a working blacksmith shop manned by a resident smith who will demonstrate the art of blacksmithing at Fort Vancouver by producing a variety of iron objects such as axe heads, trap parts, nails and hinges.

Visitors in seeing the blacksmith shop and the person demonstrating blacksmithing techniques should be able to understand the importance of blacksmithing to the daily operation of Fort Vancouver. The "working" smithy will give visitors a unique opportunity to see one of the reconstructed buildings inside the palisade actually in use producing items that would have been made by the blacksmith in 1845. They will not see just another empty building or static exhibit. The general appearance of the interior of the blacksmith shop should resemble the blacksmith shops at Lower Fort Garry in Manitoba and Old Fort William in Ontario.

Within a short time after the blacksmith has been working in the shop, the interior will appear grimy and dirty and cluttered with scraps of

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iron, etc. This appearance, as long as it does not pose a serious threat to the period tools and furnishings, should be maintained.

The park is fortunate to have a number of mid to late 19th century blacksmith tools which have been donated for the purpose of furnishing the reconstructed shop.

The tools which are relevant to the furnishing of the blacksmith shop include:

- 28 pairs of blacksmith tongs
- 1 anvil (approximately 200 lbs.)
- 1 bench vise
- 4 hammer heads
- 1 poker
- 1 wheel of measurement (this item is marked off with European measurements instead of feet or inches; it would be inappropriate for use in an English blacksmith shop)
- 1 hardy cutter
- 2 ball peen hammers
- 1 clamp ?
- 1 cold cut chisel
- 2 hot punches
- 4 prs of wagon tire wrenches?

Most of the tools listed above can be cleaned, restored and placed in the blacksmith shop. Reproductions of all of the tools needed for modern blacksmithing demonstrations should be acquired for the smithy. The person doing the blacksmithing demonstrations should be able to fabricate many of these tools.

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In studying the blacksmith shop inventories for 1844-45, it is obvious that there is a discrepancy between the two lists for both years. For reasons unknown at this time, the Outfit 1845 inventory has considerably fewer items than the 1844 inventory. Since the reconstructed blacksmith shop will be furnished and operated as a functioning mid-19th century smithy, the shop will require a considerably larger number of tools and furnishings to enable the smithy to function than are listed on the 1845 inventory. The 1845 inventory makes no mention of such crucial items to the operation of a smithy as files, a grindstone, axe and truss mandrill, coal shovels, drills or horse shoeing tools.

In furnishing a functioning blacksmith shop, it is necessary to essentially combine the two inventories for 1844 and 1845 as well as using the 1847-1848 inventories for guidance and come up with a list of blacksmithing tools that will reflect the operations of a working smithy. Therefore, the blacksmith shop will require a larger and more diverse inventory of tools than the 1845 blacksmith shop inventory.

Since the blacksmith shop will be furnished using the combined inventory for the 1844-45 as well as the 1847-48 inventories to make the shop operational, it is recommended that the 1844 inventory be used as the primary inventory for determining what furnishings are to be acquired for the blacksmith shop. In arranging and placing the tools and furnish-

FURNISHING PLAN - BLACKSMITH SHOP

ings such as the benches, anvils, grindstone, etc., these items should be located as closely as possible to the historic arrangement of 1845 based on the archaeological evidence (see plates 7,8,9,11,12,13,14,15 & 16).

It is recommended that the following items be acquired for the blacksmith shop:

101. 4 large reproduction or 1840 period iron anvils. The anvils, if at all possible, should be of the 434 pound weight or the 236 pound weight, both sizes of which were imported by the company from England. The anvils will be mounted on large blocks of hardwood, e.g. maple or oak. The anvils and blocks of wood will be positioned as closely as possible to the historic 1845 location as shown in plate 2.
102. 4 pairs of reproduction large bellows. The 4 pair of bellows will need to be reproduction items since they will need to be used in the daily operation of the blacksmith shop. The bellows will be similar to the mid-19th century bellows in the blacksmith shops at Lower Fort Garry and old Fort William in Canada. See plate 17. Blue prints of reproduction bellows fabricated by Old Fort William will serve as prototypes for the bellows for the blacksmith shop. The site curator will determine the exact specifications and arrangements for the installation of the bellows.
103. 1 pair of English handbellows, ca. 1840. These were historically imported from England for use when it was not practical or necessary to use the large bellows. They were also used to start the fire in the forges. The bellows will be hung near one of the forges.

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104. 1 reproduction 1840 period iron brace. Historically, this item was apparently made entirely of iron. See plates 41 and 42. These would have been used mainly for drilling metal. It will be placed in appropriate location in the smithy.
105. 1840 period or reproduction bow with 6 drills and breastplate. Historically, the 19th century bow drill, in its simplest form, consisted of a cylindrical or bobbin-shaped stock (round which the bow string is wound) which was mounted on a steel rod of which the lower end held the bit, and the upper end carried a head by which the stock was held and pressed against the object to be drilled. Alternately, for work on harder material such as iron or stone, the stock was pressed against the object by a "bib" or breastplate. This was usually a small metal plate curved to fit the chest to which it was secured by straps. On the outer surface of the plate was a pad of metal which contained a shallow hole which received the blunt point on the upper end of the revolving steel rod. Moxon (London) 1677 wrote a description of the operation of the drill or breastplate; "The Drill-Plate or Breast-Plate is only a piece of flat iron, fixt upon a flat Board, which Iron hath a hole punched a little way into it, to set the blunt end of the Shank of the Drill in, when you drill a hole: Workmen instead of it, many times use the Hammer, into which they prick a hole a little way on the side of it, and so set the Hammer against their Breast". The stock was rotated by the back and forth movement of a bow which imparted a reciprocating motion to the bit which was designed to cut equally well in both directions. The bow was normally

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made of wood; the cord was attached to one end, and was given a single turn round the stock and then was secured to the other end of the bow.

The bow, six drills and the breast plate will be placed in an appropriate location in the smithy; possibly on or near one of the workbenches.

106. 1 large reproduction mid-19th century style wooden bucket. The bucket should be similar to the wooden buckets in the Kitchen of the Chief Factor's House. The buckets may have metal or wooden hoops and rope or metal handles. The bucket will be placed near one of the forges full of water.
107. 1 1840 period or reproduction pressure drill. Historically, several types of pressure drills were available for use in blacksmith shops in the early to mid-19th century. Unfortunately, the Fort Vancouver blacksmith shop inventories are not specific as to the exact type of pressure drill.

Historically, one type of drill press was a lever press which consisted of a long lever attached to a wall. The lever was raised or lowered to fit the particular job by placing the lever in one of several graduated holes in a metal plate which was fastened on the underside of the lever. A drill was then wedged into the shank of the brace and placed where the hole was to be bored. Pressure was then brought to bear downward by means of the lever which kept the brace and drill steady and forced the drill to bite into the metal as the brace was turned by hand. Historically, this type of drill press was made for boring holes into cold metal.

The advantage of this type of drill was

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that it allowed a tremendous amount of pressure to be applied to the metal being drilled. Metal could be drilled more evenly and more easily. This type of drill, though, was somewhat slower to operate than the hand drills. (See plate 42).

Other types of pressure drill that would have been available would have been the beam drill. Historically, this type of pressure drill was made almost entirely of wood and was a cumbersome, yet effective, way of applying pressure to the top of a hand operated iron crank by means of a weighted beam minus any screwing down mechanism. With both types of drills, the pressure was increased by adding to the number of weights hung on the free end of the beam. The pressure could be released by raising the beam with a rope or lever.

Historically, several types of bench press drills were also available during the early to mid-19th century. As the name implies, these types of drills were mounted on the bench itself or on the wall above the bench with a swinging jib overhanging the bench. The jib or arm could be easily moved radially or extended telescopically towards the operator of the drill press and could be fixed in a position by a locking screw. The bit was hand driven by means of an iron crank or brace on which pressure was exerted from above by a vertical screw. The screw would be given a turn from time to time in order to keep the drill pressed down on the object.

It is doubtful, because of the size of the interior of the blacksmith shop, that the shop would have been equipped

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with a beam drill, at least not a large one.

The lever pressure drill or the bench pressure drills would not have required so much space; the bench pressure drills requiring less space than the lever pressure drill.

The blacksmith shop should be furnished with either a lever pressure drill or a bench or "post" press drill. If the bench drill is used, it will be mounted on one of the benches. The lever pressure drill would also need to be mounted on one of the benches.

108. 1/2 dozen assorted reproduction 1840 period files. Historically, steel files were imported from England from three suppliers to the Hudson's Bay Company; Benjamin T. Fenton, Moreton and Foster, Parker and Potts and Co.⁶⁸ (For a detailed discussion of the manufacturing process for files, see pps. 1155-1160, Vol. VI Archaeological Report).

Historically, a large number of assorted files were imported and used at Fort Vancouver including:

Flat Bastard Files-7,8,10,12,14,15
inch
Flat Smooth Bastard Files-6,7,8,
10,12,13,14 inch
Half Round Bastard Files-6,7,8,9,10,
11,12,14 inch
Round Bastard Files-11 to 14 inch
Blacksmiths Rubber Files-62 and 84
pounds
Flat Rasp Files-8,10,12 inch
Half Round Rasp Files-7,8,10 inch
Rattail Files-6,8,10 inch
Round Files-8 inch
Cross Cut Saw Files-6,6 1/2, 8 1/2
inch

68. Archaeological Report. Vol. VI. p. 1155

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Hand Saw Files- 4 1/2, 5 inch
Pit Saw Files, 5 1/2, 6 inch
Tenon Saw Files- 3 inch
Half Round Smooth Files-8, 10, 12 inch
Three Square Files-8, 10, 12 inch ⁶⁹

Since the 1844 inventory for the blacksmith shop lists just six files and the 1845 inventory lists none, and, since files would have been a necessary item in a shop of this period, it is recommended that the 1844 inventory be followed and that six files should be acquired. The six files should be an assortment of 1 flat bastard file, 7", 8", 10", 12", or 14" or 15".
1 half round bastard file, 6", 7", 8", 9", 10", 11", 12", or 14".
1 round bastard file, 11", 14".
1 flat rasp file, 8", 10", or 12".
1 half round rasp file, 7", 8", or 10".
1 cross cut saw file, 6", 6 1/2", or 8 1/2".

The files will be placed on one of the work benches; some may be fixed in an appropriate manner to the wall over the work bench. (See plate 32).

109. 1 reproduction or 1840 period treadle or crank grindstone.
Historically, a number of types of grindstone were imported by the company into the Columbia Department including:
- a. common grindstones
 - b. hard grit holed grindstones;
19, 36 and 42
 - c. fine grit holed grindstones; 19
 - d. large grindstones
 - e. small grindstones

69. Archaeological REport. Vol. VI. p. 1156

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It is not presently known which type of grindstone would have been used in the blacksmith shop in 1844-1845. It is recommended that the type of grindstone that is presently in the blacksmith shop at Lower Fort Garry be used as a prototype for the grindstone to be acquired for the reconstructed smithy. The grindstone will be placed in location as close to the archaeological location of the grindstone as possible.

110. 4 1840 period 3-5 pound bench hammers. Historically, bench hammers were also called ball peen hammers. The hammers will be placed on one of the benches.
111. 4 1840 period 5-20 pound hand hammers. Historically, this type of hammer was apparently used to forge hot metal on the anvil.⁷⁰
112. 3 1840 period 5-20 pound sledge hammers. Historically, sledge hammers would have been used for heavy metal work. The sledge hammers will be placed in an appropriate location.
113. 15 reproduction or 1840 period axe mandrils. Historically, mandrils were used for shaping metal into a closed shape (see plate 29). Unfortunately, the sizes of the axe mandrils on the blacksmith shop inventories are not known at the present time. The axe mandril at Fort William is 5/8" thick, 37" high; 2 1/4" in diameter at the top and the diameter of the hole is 1". For variety, the size of the mandrils should be graduated. The axe mandrils will be placed in appropriate locations.

70. Interview with Henry Hansen, 7-13-80. Note: the writer's father was a blacksmith in the early 1900's who was apprenticed to a blacksmith who had learned his trade in the 19th century. The writer's father was thoroughly familiar with mid to late 19th century blacksmithing tools and techniques.

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114. 70 reproduction or 1840 period assorted axe mandril punches. Historically, this type of punch would have been used for stamping, indenting and punching holes in iron or other metal. Axe mandril punches would have been used in the manufacture of axe heads.⁷¹ (see plate 26). The 1844 inventory lists 20 axe mandril punches; the 1845 inventory lists 70. The large increase in the number of punches from one year to the next cannot be logically explained at the present time. Perhaps, some punches had been transferred from the blacksmith shop at the sawmill to the fort smithy by 1845. The punches should be of graduated sizes from four to eight inches long. They should be square, round and oval in shape. The mandril punches will be placed on one of the benches.
115. 20 reproduction or 1840 period nail moulds or borers. Historically, this item was used for manufacturing "country made" wrought rod fasteners (including nails and rivets). One archaeological example of a nail mould was found at Fort Vancouver and it was used to make round shank countersunk fasteners.⁷² The reproduction nail molds or borers should be based on the recovered archaeological sample. (see plate 23). They will be placed in an appropriate location.
116. 1 reproduction 1840 period truss hoop mandril. Historically, this item apparently was used in the manufacture of iron rims for wagon or cart wheels.⁷³ The reproduction truss

71. Archaeological Report. Vol. VI. p. 1167

72. Archaeological Report. Vol. VI. p. 1165

73. Interview with Henry Hansen by David K. Hansen, 7-13-80

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hoop mandril should be based on the one shown in plate 20. It will be placed in an appropriate location.

117. 1 1840 period or reproduction traveler. Historically, this item was used for obtaining the true circumference of a wheel or barrel. It was a wheeled instrument with inch markings. By counting the number of revolutions made by this instrument as it travelled around the object and adding the final measure, the proper sized part could be made.⁷⁴ The traveler will be placed on one of the benches along the walls.
118. 6 reproduction or 1840 period small screw plates. Historically, this item was a flat brass or iron plate, usually with a handle with graduated threaded holes for threading screws.⁷⁵ A respective number of tops should also be acquired along with the plates. (See plate 21). The screw plates and tops will be placed in an appropriate location in the shop.
119. 1 reproduction pan. Historically, it is not known what a pan would have been used for in the blacksmith shop. Perhaps it was used by the blacksmith for washing purposes. If it were used for washing purposes, it would probably have been a "country made" tin washbasin. The pan to be acquired for the blacksmith shop will be similar to the tin washbasins in the steward's quarters in the kitchen structure. The pan may be hung on the wall.
120. 2 reproduction 1840 period fire pokers. Historically, these

74. Archaeological Report. Vol. VI. p. 1144

75. Archaeological Report. Vol. VI. p. 1165

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items were used to stir the fire in the forges and would have been made of iron rods worked by the blacksmith. The pokers to be acquired for the blacksmith shop should be based upon those shown in plate 18. The pokers will be placed near one of the four forges.

121. 4 reproduction 1840 period blacksmith's fire rakes. Historically, these items would have been used for raking or moving the hot coal in the surface of the forges. The rakes should be graduated in size. The rakes will be based upon those shown in plate 18. The rakes will be placed near the forges.
122. 1 or 2 reproduction 1840 period writing slates. The immediate purpose of this item is not presently known. Perhaps, a slate was used by the blacksmith, if he was literate, upon which to list the day's tasks. "Slate" was also used to refer to a slate or soapstone pencil, for marking an iron. In any event, the slate should be similar to those in use during the 1840's. The slate should have a wooden frame. Several slate pencils should also be acquired for use with the slate. The slate may be hung or placed on or near one of the benches.
123. 4 reproduction 1840 period fire shovels. Historically, this item would have been used for shoveling hot coals into the forges. The shovels would have been made of iron by the blacksmiths. The shovels should be based upon the shovels shown in plate 18. The shovels will be placed near the forges.
124. 1 reproduction 1840 period coal shovel. Historically, this item would have been used for shoveling coal from a coal pile or box or other receptacle into the forges. The coal shovel to be acquired should be based on the shovel shown in plate 18. The coal shovel will be placed in or near the coal box.

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125. 54 pair of assorted reproduction or 1840 period blacksmith tongs. Historically, tongs, which were "country made" by the blacksmiths, were used for handling hot iron while in the process of being forged into various tools and other items. Most tongs were made of round iron stock with handles ranging from two to three feet in length. ⁷⁶
- The tongs to be acquired for the shop should be of various sizes with jaws of sizes and handles of various lengths. The tongs will be placed around the forges and around the anvils following the manner of the blacksmith shops at Lower Fort Garry and Old Fort William.
126. 1 set of reproduction or 1840 period horse shoeing tools. Historically, such a set would probably have consisted of the following items:
- several hammers
 - a rasp
 - pincers (to snip off the ends of nails)
- 77
- Because the individual items are not listed separately on the blacksmith shop inventories, it is difficult to document what tools were in a complete or partial set. It is recommended that several mid-19th century English horse shoeing hammers, several English horse shoeing rasps and several English pincers be acquired. The horse shoeing tools will be placed in a wooden carrying case. The case with tools will be placed in an appropriate location.
127. 3 reproduction or 1840 period leg vises. Historically, these

76. Archaeological Report. Vol. VI. p. 1175

77. Interview with Henry Hansen by David K. Hansen, 7-13-80

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would have been used for holding metal when filing, drilling, boring, shaping and assembling. Such vises would have been attached to large wooden benches. This type of vise was generally a floor to bench size with turn screw jaws which were forced open by a large leaf spring.⁷⁸ Historically, only one style in three sizes, 61, 107, and 117 pounds were imported by the company for use at Fort Vancouver.⁷⁹ It is recommended that three reproductions or 1840 period bench vises of the type described in the Archaeological Report and shown in plate 15 be acquired. The vises, if at all possible, should be of the weight of those described in the Archaeological Report. The vises will be affixed to one of the benches with a leg sunk into the ground.

128. 2 reproduction or 1840 period hand or bench vises. Historically, this type of vise could also have been attached to a bench, but would have been smaller in size than the large bench vises. The hand vise was used to hold small items while they are being filed. Historically, the vise was held in the left hand and the parts of the iron, while being pressed upon the end of the bench or upon a piece of wood or bone in the large vise, is successively turned to the file, which was held in the right hand. A nick was made in the wood or bone to keep the work from being carried aside by the file. The two hand vises should be similar to those shown in plate 15. The vises will be affixed to one of the benches.

78. Archaeological Report. Vol. VI. p. 1183

79. Ibid. p. 1183

FURNISHINGS PLAN - BLACKSMITH SHOP

The 1845 inventory lists a number of items which are not listed on the 1844 inventory including cold chisels and stocks and dies with tops. It is not known why these items were omitted from the 1844 blacksmith shop inventory, but their presence in a smithy of this period would have been essential. They may have been carelessly omitted by whoever took the inventory, or they may have been transferred to another blacksmith shop. They may also have been "country made" which would not have merited listing.

129. 6 reproduction or 1840 period cold chisels. Historically, hot and cold chisels were in common use in the blacksmith shop at Fort Vancouver; but only cold chisels were listed on the company inventories.⁸⁰ Historically, cold chisels were tempered or heat treated to preserve their cutting edge. Cold chisels were used for marking or driving a hole through cold metal. Such chisels were used with either a wrapped or insert hardwood handle. Wrapped handles usually consisted of a wooden branch wrapped once around the neck of the tool with the ends being together and extending one to two feet out from the tool.⁸¹ The cold chisels should be based on those shown in plates 33 and 34. The cold chisels will be placed near the forges and anvils.

130. 6-8 reproduction or 1840 period stocks, dies and taps. Historic-

80. Archaeological Report. Vol. VI. pps. 1152-1155

81 Ibid. p. 1155

FURNISHINGS PLAN - BLACKSMITH SHOP

ally, stocks, dies and taps were used to thread round shanks by twisting the shanks through the dies. Taps were similarly used to thread nuts. ⁸² (see plates 22, 27 and 28). The company carried the following stocks, dies and tap related items on its inventories:

- Blacksmith screw plates with taps, 3/8 to 3/4"; 1/2 to 1".
- Complete screw plates
- gunsmiths screw plates 24 hole, 1/4"
- downwards screw plates with 5 taps
- small screw plates
- tap screws or borers
- complete stock and dyes (sic)
- stock and dyes (sic) with 3 taps
- tap borers ⁸³

The stocks, dies and taps should be based on those items shown in plates 22, 27 and 28. The stocks dies and taps will be placed in an appropriate location.

The blacksmith shop inventories for the succeeding years of 1847 and 1848 list a number of blacksmith tools which are not listed on the 1844 and 1845 inventories. The presence of a number of these tools in an Hudson's Bay Company blacksmith of the 1840's would appear necessary and essential for a well-stocked and working blacksmith shop. Such tools and objects would have included:

- iron rules
- pair of interior and exterior callipers
- stock shears

82. Archaeological Report. Vo. VI. p. 1167

83. Ibid. p. 1167

FURNISHINGS PLAN - BLACKSMITH SHOP

flatters
fullers
hot sets or hardys
sledge hammers
swages
screwdrivers
wrenches
burnishing irons
broach iron or reamers
quench tubs

see plates 25, 30, 31, 33 and 40

131. 2 reproduction or 1840 period iron rules. Historically, iron rules would have been used for measuring the flat surfaces of metal. The rules to be acquired should be based on the rule shown in plate 40. The rules may be placed on one of the benches; or they may hang over the bench or they may hang near one of the forges close to the blacksmith's activity.
132. 3 pair of reproduction or 1840 period stock shears. Historically, stock shears would have been used for cutting metal. A number of styles of stock shears could have been used in the blacksmith shop in 1845 including hand shears and a floor type, which may have logically been the type used in the Fort Vancouver smithy for cutting large pieces and sheets of metal. The floor type shears sat on the floor and the blades or cutting portion was activated by a three or four foot long handle. One of the pairs of shears should be the floor type; the other two pair may be the hand type. The floor type shears may be mounted on one of the benches; the hand shears may be placed at appropriate locations in the smithy.

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133. 2 pair of reproduction or 1840 period 12" inside and outside callipers. Historically, callipers were used for measuring and drawing circles on metal. The callipers to be acquired for the blacksmith shop should be based on the 1840 period callipers. The callipers will be placed in or on one of the benches.
134. 7 or 8 reproduction or 1840 period flatters. Historically, flatters were iron hand tools for flattening metal stock. The flatters to be acquired for the blacksmith shop should be based on those shown in plate 31. The flatters may be placed near the anvils.
135. 8-10 reproduction or 1840 period fullers. Historically, fullers were tools used for thinning metal stock. Both the fuller and swage generally consisted of a matching bottom and top tool. The essential difference was that the fuller made a round groove or hollow, spreading the metal in one direction only; it reduced the metal at one point. The fuller was equipped with a wooden handle similar to a hammer which held on the swage. The fullers to be acquired for the blacksmith shop will be based on 1840 period fullers. The fullers will be placed near the anvils.
136. 2 or 3 reproduction or 1840 period swages. Historically, the swage was used mainly for finishing round material. See plate 25. The swage was held in place on the anvil by means of a square shank which extended downward and fitted into the hardie hole in the tail of the heel of the anvil. The swages to be acquired for the blacksmith shop should be based

FURNISHINGS PLAN - BLACKSMITH SHOP

on those shown in plate 25. The swages will be placed next to the anvils.

137. 10-12 reproduction or 1840 period hardies or hot sets. Historically, hardies were used for cutting hot metal on the anvil; a hardy was placed in the hole in the anvil and metal would be cut on the sharp edge of the hardy. The hardies to be acquired for the blacksmith shop should be based on those shown in plate 30. The hardies will be placed near the anvils.
138. 2 or 3 reproduction or 1840 period sledge hammers. Historically, the sledge or sledge hammer was the heaviest of the blacksmith's hammers and weighed from five to twenty pounds. The sledges had wooden handles. The sledges to be acquired for the blacksmith shop should be based on those shown in plate 47. The sledges will be placed near the anvils.
139. 2 or 3 reproduction or 1840 period screwdrivers. Historically, this item was sometimes referred to as a turnscrew. This tool generally consisted of a steel blade ground at one end to a flat edge for fitting into the slot on the head of a screw in order to turn it. The length of the blade often varied from two to twenty-four inches, depending upon the use of the tool. In all but the smaller sizes, the flat heel of the blade, just above the tang, was fitted into a slot in the ferrule. The screwdrivers to be acquired for the blacksmith shop should be based on 1840 period screwdrivers. The screwdrivers may be placed on one of the benches.

FURNISHINGS PLAN - BLACKSMITH SHOP

140. 2 or 3 reproduction or 1840 period wrenches. Historically, this tool was used for gripping and tightening nuts and bolts. Historically, there were several types of wrenches used by blacksmiths during the early and mid-19th century. Two common types included the wrenches with fixed spanners and those with wedge spanners (slip wrenches). The slip wrench had a lower jaw which slid up or down the shaft of the spanner, and was locked by an iron wedge. The wrenches to be acquired for the blacksmith shop should be of the two types previously discussed. The wrenches should be graduated in size. The wrenches may be placed on one of the benches or near one of the anvils.
141. 1 or 2 reproduction or 1840 period burnishing irons. Historically, this item was similar to a file without teeth. It was very smooth and had a handle. It was used to give a bright finish to the iron. The burnishing irons to be acquired for the blacksmith shop should be based on 1840 burnishing irons. The irons may be placed near the anvils.
142. 1 or 2 reproduction or 1840 period broaches. Historically, this item was also known as a reamer. The broach or reamer was a steel tool, generally tapered and ploygonal in form, with from four to eight cutting edges for smoothing and enlarging holes in metal. It was sometimes made smooth or without edges. The broaches or reamers to be acquired for the blacksmith shop should be based on 1840 period broaches. The broaches or reamers may be placed near the forge, anvils or on one of the benches.
143. 2 reproduction large oak tubs. Historically, these items would

FURNISHINGS PLAN - INDIAN TRADE STORE

would have been used for cooling metal items after being removed from the forge by the blacksmith. Two modern oak tubs sink in the ground will serve as the quenching tubs. The tubs will be filled with water.

The blacksmiths who were employed in the smithy making the various metal items would have needed stock material from which to fashion them. The most common used metals for smithing purposes were iron (with low carbon content) and steel (high carbon content).⁸⁴ The company imported iron and steel from three sources:

Jukes Coulson and Co.
Pelly, Boyle and Co.
R and W Crawshaw and Co.

The types of iron imported into the Columbia Department included:

Best Flat Bar Iron	
- 6 x 3/16 inch	- 1 3/4 x 3/8 inch
- 1/2 x 1/4 inch	- 2 1/2 x 3/8 inch
- 7/8 x 1/4 inch	- 2 1/2 x 1/2 inch
- 1 x 1/4 inch	- 3 x 5/8 inch
- 1 x 3/8 inch	- 2 1/2 x 7/8 inch
- 1 3/8 x 3/8 inch.	- 3 x 7/8 inch

84. Archaeology Report. Vol. VI. p. 1080

85. Ibid. p. 1080

FURNISHINGS PLAN - BLACKSMITH SHOP

Best Round Bolt Iron

-1/4 inch	-7/8 inch
-3/8 inch	-1 inch
-1/2 inch	-1 1/8 inch
-5/8 inch	-1 1/4 inch
-3/4 inch	-1 1/2 inch

Hoop Iron

-No. 10, 1 1/2 inch	-3/4 x 1/10 inch
-No. 11, 3/4 and 1 1/2 inch	-1 1/4 x 1/8 inch
-3/5 x 1/10 inch	-1 1/8 x 1/4 inch
-1 x 1/16 inch	-1 3/10 x 1/2 inch
-1 1/10 x 1/12 inch	

Truss Hoops

Best Scrap Iron

-Flat	
-7/8 x 1/4 inch	-1 1/4 x 5/8 inch
-1 x 1/4 inch	-3 x 5/8 inch
-3/4 x 3/8 inch	-1 1/2 x 3/4 inch
-1 x 3/8 inch	-2 1/2 x 7/8 inch
-1 1/4 x 3/8 inch	-3 x 7/8 inch
-2 1/4 x 1/2 inch	-2 x 1 inch
-2 1/2 x 1/2 inch	

-Square

-1/2 inch
-3/4 inch
-1 inch

Best Charcoal Scrap Iron

-No. 2, 5/8 x 1/8 inch
-No. 3, 1 x 1/8 inch
-1 x 1/8 inch

Single & Double Sheet Iron

-1/4 inch	-1 3/8 inch
-3/8 inch	-1 1/2 inch
-1/2 inch	-2 inch
-5/8 inch	-2 1/2 inch
-3/4 inch	-3 inch
-7/8 inch	-4 inch
-1 inch	-4 1/2 inch
-1 1/4 inch	

Wrought Sheet Iron, 24 x 14 x 3/10 inch

Best Square Iron

-1/4 inch	-3/8 inch
-1/2 inch	-5/8 inch
-3/4 inch	-7/8 inch

Wrought Iron -- "Country made".

FURNISHINGS PLAN - BLACKSMITH SHOP

Steel -- High quality Iron was called steel; the only known supplier for the Hudson Bay Company was Crowley, Millington & Co.

Cast Steel

Best Coachspring Steel, 1 1/8 x 3/16 inch.

Crowley Steel

-1 1/2 x 3/8 inch

-1 5/8 x 1/2 inch

Best German Steel

-1 1/8 x 1/8 inch -1 1/2 x 3/8 inch

-1 1/8 x 3/16 inch -1 1/2 x 1/2 inch

-1 3/8 x 1/4 inch -1 5/8 x 1/2 inch

-3 1/2 x 1/4 inch -2 x 1/2 inch

-1 1/8 x 3/8 inch -2 1/4 x 1/2 inch

Wrought Steel -- "Country made". ⁸⁶

144. Stock iron for the blacksmith shop. It is recommended that sufficient quantities of flat bar, round bolt and single and double sheet iron be acquired for the blacksmith shop. The iron stock should be of the historic dimensions if at all possible. The stock will be placed in an appropriate location in the smithy. See Plate 19. The stock will be used by the blacksmith to manufacture items in the daily operations of the shop.

145. Stock steel for the blacksmith shop. It is recommended that sufficient quantities of cast and other steel stock appropriate to the 1845 be acquired for the blacksmith shop. The steel stock should be of the historic dimensions if at all possible. The stock will be placed in an appropriate location. The steel stock will be used by the blacksmith to manufacture items in the daily operation of the shop.

86. Archaeological Report. Vol. VI. pps. 1080-1082.

FURNISHINGS PLAN - BLACKSMITH SHOP

146. 2 reproduction coal receptacles. The coal receptacles to be acquired for the blacksmith shop should be based on coal receptacles used at the Hudson Bay Company blacksmith shops at Lower Fort Garry or Old Fort William. The receptacles will be placed near each forge. The receptacles will be filled with coal.
147. Modern blacksmith coal. It is recommended that an appropriate type of coal be acquired for the blacksmith shop. Historically, seacoal was imported by the company into the Columbia Department for use in the forges at Fort Vancouver. By the late 1840's, some coal was also imported from Vancouver Island. Some of the samples of coal recovered during the archaeological excavations were apparently anthracite or hard coal which would have been imported from England.⁸⁷ Charcoal, which was both imported from England and "country made", was also used in the blacksmith shop forges.⁸⁸
- Some coal will be piled outside the blacksmith shop, the remainder will be placed in the coal receptacles in the smithy. A supply of coal should also be kept on hand for display purposes.
148. 4 anvil bases. Four wooden bases to support the four anvils will be acquired for the blacksmith shop. The bases should be a local northwest hardwood such as maple. The bases should be placed using the hypothetical archaeological drawing (see plates 4 and 5) as a guide. The bases should be similar to those shown in plate 13. They should be sunk in the ground.

87. Telephone Interview with Jake Hoffman, National Park Service Archaeologist, Denver Service Center, 7-24-80. According to Hoffman, he was not absolutely certain of the quality of the coal but the samples he saw appeared to be of good quality and therefore would probably have been anthracite.

88. Archaeological Report. Vol. VI. p. 1086

FURNISHINGS PLAN - BLACKSMITH SHOP

149. 2 reproduction 1840 period blacksmith's leather aprons. The aprons will be worn by the smith.

The general appearance of the blacksmith shop should be cluttered with tools, scraps of iron and bits of coal. The smithy should look well used. It should definitely not appear neat and clean.

The tools and implements should be arranged in a manner similar to the arrangement of the tools in the blacksmith shops at Lower Fort Garry and Old Fort William.

A number of finished and half-finished items such as hinges, traps and trap parts, axe heads, shovels and hoes should be placed around the smithy to indicate the manufacture of these items by the blacksmith.

FURNISHINGS PLAN - BLACKSMITH SHOP

Tinsmithing

Blacksmithing was apparently not the only function that was carried on in the blacksmith shop in the 1840's. According to archaeological evidence, numerous fragments of cut sheet metal or tin were recovered from the site of the 1845 Blacksmith Shop.⁸⁹

Various company inventories for Fort Vancouver over a period of years listed both "country made" and imported tin items such as coffee pots, porringers, tureens, funnels, canisters, soup ladles and pots.

The company imported into the Columbia Department four grades of tin for manufacturing "country made" tin items:

DXXXX
F. Cr.
IX 90
SDXX

The significance of the symbols for the system of grading the tin is presently unknown.⁹¹

Since tin was imported and used at Fort Vancouver to make the previously mentioned items, a structure for manufacturing them would logically have

90. Archaeological Report. Vol. VI. p. 1084

91. Ibid. p. 1084

FURNISHING PLAN - BLACKSMITH SHOP

been needed. No other building within or outside the fort has yet been identified as being used for tinsmithing activities.

It is reasonable then to assume, based upon the available archaeological and historical evidence, that tinsmithing activities could have been carried on in the blacksmith shop.⁹² The tinsmiths would have probably used a corner of the smithy for their work. For a description of the types of mid-19th century tinsmithing practices and techniques, see Appendix V. One work bench or a portion of a bench would have held their tools and served as a place to fabricate tin items. The forges would have provided necessary heat to melt the solder used in assembling the tin items.

Unfortunately, there are no inventories of tinsmithing tools for Fort Vancouver for 1845 or for any year for that matter.⁹³ There is no apparent explanation for the absences of an inventory of tinsmithing tools.

An inventory of tinsmiths' tools at Fort William for September 18, 1816 listed the following:

6 anvils 10/ 15/ 25/ 30/ 40/ 60/	
53 sheets Tin large size	136 sheets Tin small size
2 Crest Irons	2 Swedges
4 large Soldering Irons	2 Large round faced Hammers
11 Small Hammers ⁵ 275 ⁶ 376	1 pr Large bench Shears
1 pr Midg: bench shears	2 hand " "
1 Small Bench Vise	2 pr Iron Compasses

92. Telephone Interview with John Hussey by David K. Hansen, 7-21-80. Hussey confirmed possibility that tinsmithing could have been carried out in the blacksmith shop.

93. Telephone Interview with John Hussey by David K. Hansen, 6-5-81

FURNISHINGS PLAN - BLACKSMITH SHOP

- 46 lb. Iron Wire
- 1 Iron Square broken
- 1 pad Lock
- 1 Cupboard
- 1 Rivet Iron
- 7 Punches & Chisels
- 1 Soldering Stool

Using this inventory for comparative purposes, it is possible to conclude that, if tinsmithing was carried on in the blacksmith shop at Fort Vancouver in 1845, the tinsmiths would have had and used tools probably similar to those at Fort William.

Based upon the archaeological evidence, it is recommended that a small portion of the blacksmith shop be set aside to interpret the importance of tinsmithing at Fort Vancouver in the 1840's. One of the work benches should be used to hold various tinsmithing tools, sheets of tin and half-finished and finished tin items such as soup tureens, milk strainers, faunels, tea pot stands and porringers.

The following tinsmithing tools and furnishings similar to those listed on the 1816 Fort William inventory should be acquired:

150. 4-6 reproduction 1840 period soldering irons. The irons should be similar to those in plates 43 and 46. The irons should be of various sizes. They will be mounted on a large block of wood near the bench.

FURNISHINGS PLAN - BLACKSMITH SHOP

151. 1 reproduction 1840 period charcoal stove. The stove should be similar to the one in plate 46. The stove will sit on top of a piece of flat sheet iron, which in turn, will rest on bricks. All of these items will rest on a large block of wood.
152. 1 reproduction wooden stool. The stool should be like those found in counting houses and shops of the 1840's. The stool should be fairly tall. It will be painted Spanish brown. It will be placed near the bench with the tinsmith's tools.
153. 1 1840 period tinsmith's anvil. The anvil will be placed on the bench.
154. 1 reproduction or 1840 period stake iron. The stake iron will be placed on the bench.
155. 1 reproduction or 1840 period hatchet stake. The hatchet stake will be placed on the bench.
156. 1 reproduction or 1840 period candle mold stake. The stake will be placed on the bench.
157. 1 reproduction or 1840 period tinner's swage. The swage will be placed on the bench.
158. 2 reproduction or 1840 period riveting hammers. The hammers will be placed on the bench; one hammer may be hung on the wall above the bench.
159. 2-4 small reproduction or 1840 period hammers. The hammers will be placed on or near the tinsmith's anvil.
160. 1 reproduction or 1840 period tinsmith's bumping hammer. The hammer will be placed with the other hammers.
161. 1 reproduction or 1840 period ball peen hammer. This hammer will be placed with the other hammers.

FURNISHINGS PLAN - BLACKSMITH SHOP

162. 1 reproduction or 1840 period round faced hammer. This hammer will be placed with the other hammers.
163. 1 reproduction or 1840 period tinner's punch. The punch will be placed near the anvil.
164. 2-3 reproduction or 1840 period punches. These punches will also be placed near the anvil.
165. 2 reproduction or 1840 period round punches. These punches will be placed with the other punches.
166. 2 pair of reproduction or 1840 period tinsmith's metal shears. The two pair of shears should be of different sizes. The shears will be hung over the tinsmith's bench.
167. 1 reproduction or 1840 period bench vise. The vise will be mounted on the bench.
168. 2-3 pair of reproduction or 1840 period tinsmith's callipers. The callipers may be hung on the wall over the bench; one pair may be placed on the bench.
169. 2 pair of reproduction or 1840 period nippers. The nippers will be placed on the bench.
170. 1 reproduction or 1840 period seaming stake. The stake will be placed on the bench.
171. 1 reproduction 1840 period candle or chamberstick. This item will serve as the pattern from which the tinsmith would have produced the "country made" chamber or candlesticks. The stick may be placed on the bench.
172. 1 reproduction 1840 period tin teapot. The teapot will be similar to Fort Vancouver catalog #12,895 in the Kitchen. The teapot will be placed on a bench or on the shelf above the bench.
173. 1 reproduction 1840 period tin soup tureen. The soup tureen will be similar to Fort Vancouver catalog

FURNISHINGS PLAN - BLACKSMITH SHOP

#12,895 in the Kitchen. The tureen will be placed on a shelf above the tinsmith's bench.

174. 1 reproduction 1840 period tin porringer. The porringer will be similar to Fort Vancouver catalog #12,936 in the Kitchen. The porringer will be placed on the shelf above the bench.
175. 2-3 reproduction 1840 period single wall sconces. The sconces will be similar to the single wall sconces in the Chief Factor's House and Kitchen. The sconces will be placed on the shelf above the bench.

A number of finished and half-finished tin items should be arranged on and around the tinsmith's work bench. Some of the items may sit on the bench, be placed on the shelf above the bench, or even hung from one of the beams. The unfinished tin items will sit on the bench.

176. 2 finished reproduction 1840 period tin candle lanterns. The lantern will be similar to the tin candle lanterns in the Chief Factor's House and the Kitchen. The lanterns may be hung above the tinsmith's bench.
177. 2-4 finished reproduction 1840 period tin candle molds. The candle molds should be similar to Fort Vancouver catalog #12,976. The molds may be of the 4, 6 or 8 mold variety. The molds may be placed on a shelf above the bench or may be hung up.

FURNISHINGS PLAN - BLACKSMITH SHOP

178. 4 or 5 finished reproduction 1840 period tin soup ladles. The soup ladles should be similar to the tin soup ladles in the Kitchen. Some of the ladles may be placed on the bench; some may be hung above the bench.
179. 5-6 finished reproduction 1840 period tin cups. The cups will be similar to "country made" tin cups made at Fort Vancouver in the 1840's. The cups will be placed on a shelf above the bench.
180. 3 unfinished reproduction 1840 period tin measures. The measures will be placed on the bench.
181. 4-5 unfinished reproduction 1840 period tin canisters. The canisters will be similar to the tin canisters in the Kitchen. The canisters may be one pound, two pound, or one-fourth pound in size. The canisters will be placed on the bench.
182. 6-7 unfinished reproduction 1840 period tin porringers. The porringers will be similar to Fort Vancouver catalog #12,936 in the Kitchen. The porringers will be placed on the bench.
183. 2 unfinished reproduction 1840 period tin collanders. The collanders will be similar to Fort Vancouver catalog #12,319 in the Kitchen. The collanders will be placed on the bench.
184. 1 unfinished reproduction 1840 period tin milk strainer. The milk strainer will be similar to Fort Vancouver catalog #12,662 in the Kitchen. The milk strainer will be placed on the bench.
185. Tin sheets. A number of sheets of modern tin of the size and weight appropriate to the 1845 period should be acquired. The tin sheets will be placed in an appropriate location.

FURNISHINGS PLAN - BLACKSMITH SHOP

The appearance of the tinsmith's portion of the blacksmith shop should convey the impression that the tinsmith is busily engaged in his trade. The area should be littered with tin scraps.

V. COMMENTS ON MAINTENANCE OF FURNISHINGS
FOR THE BLACKSMITH SHOP

The furnishings in the reconstructed blacksmith shop will need to be maintained on a regular basis. All of the iron and other metal objects will need to be checked by the park curator on a bi-weekly basis for oxidation or deterioration due to the presence of coal dust from the working forges.

Because the blacksmith shop is unheated, oxidation of the metal objects will occur at a faster rate in the winter and during the damp and rainy months than in the summer. All tools and objects that are lightly or even moderately oxidized will need to be cleaned as often as required. Those that are subject to heavy oxidation will require even more attention. After proper cleaning, all of the metal objects should be coated with Browning's Ultra Fine Gun oil or tung oil.

Special care should be given to the period metal objects in the blacksmith shop.

The period objects will need to be inspected regularly to see that they are not deteriorating significantly due to consumptive use in the day to day operations of the blacksmith shop.

The curator will supervise and work with the blacksmith in the general cleaning and maintenance of all of the metal objects in the smithy.

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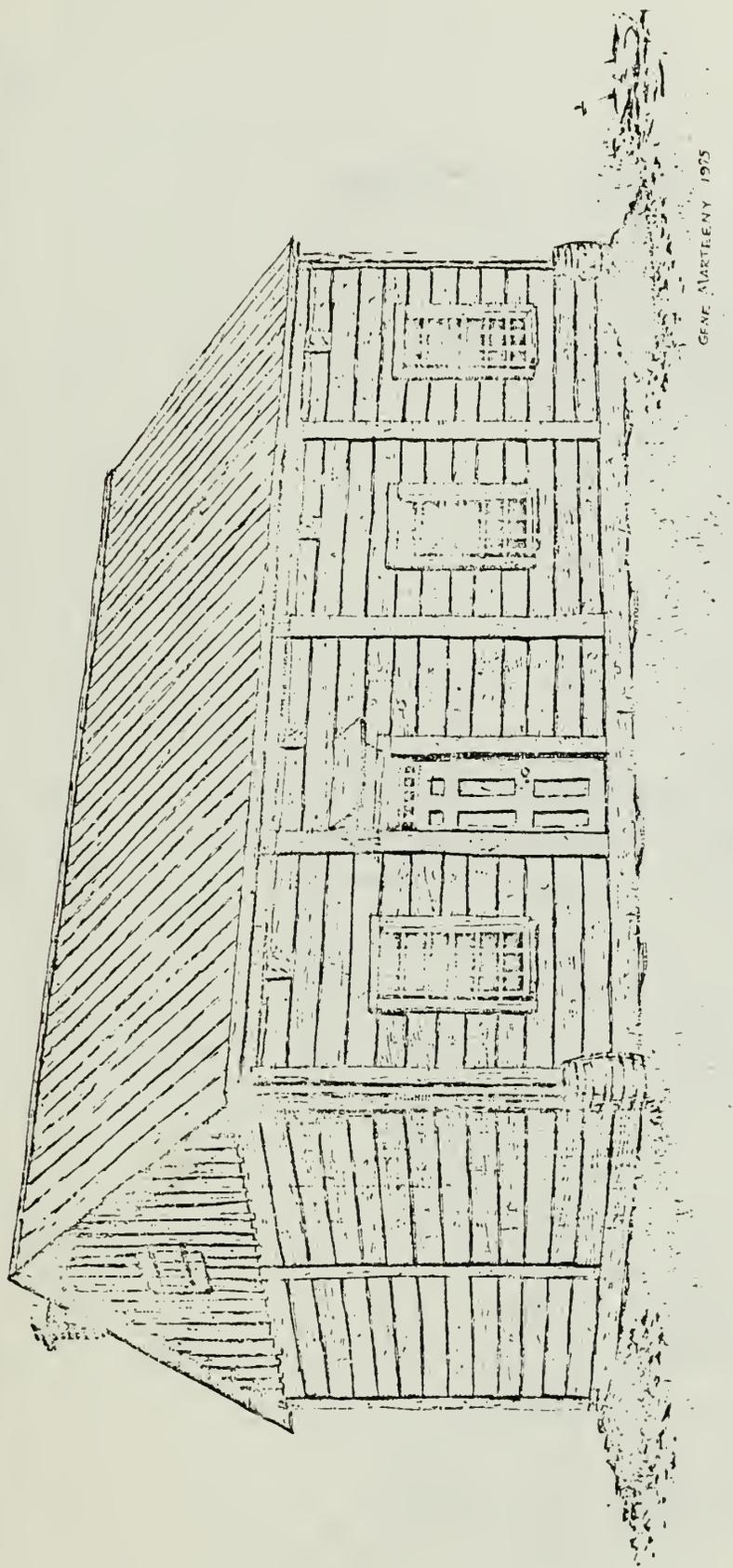
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PLATE 1

Historical Archaeological Reconstruction
of Second Blacksmith Shop Exterior

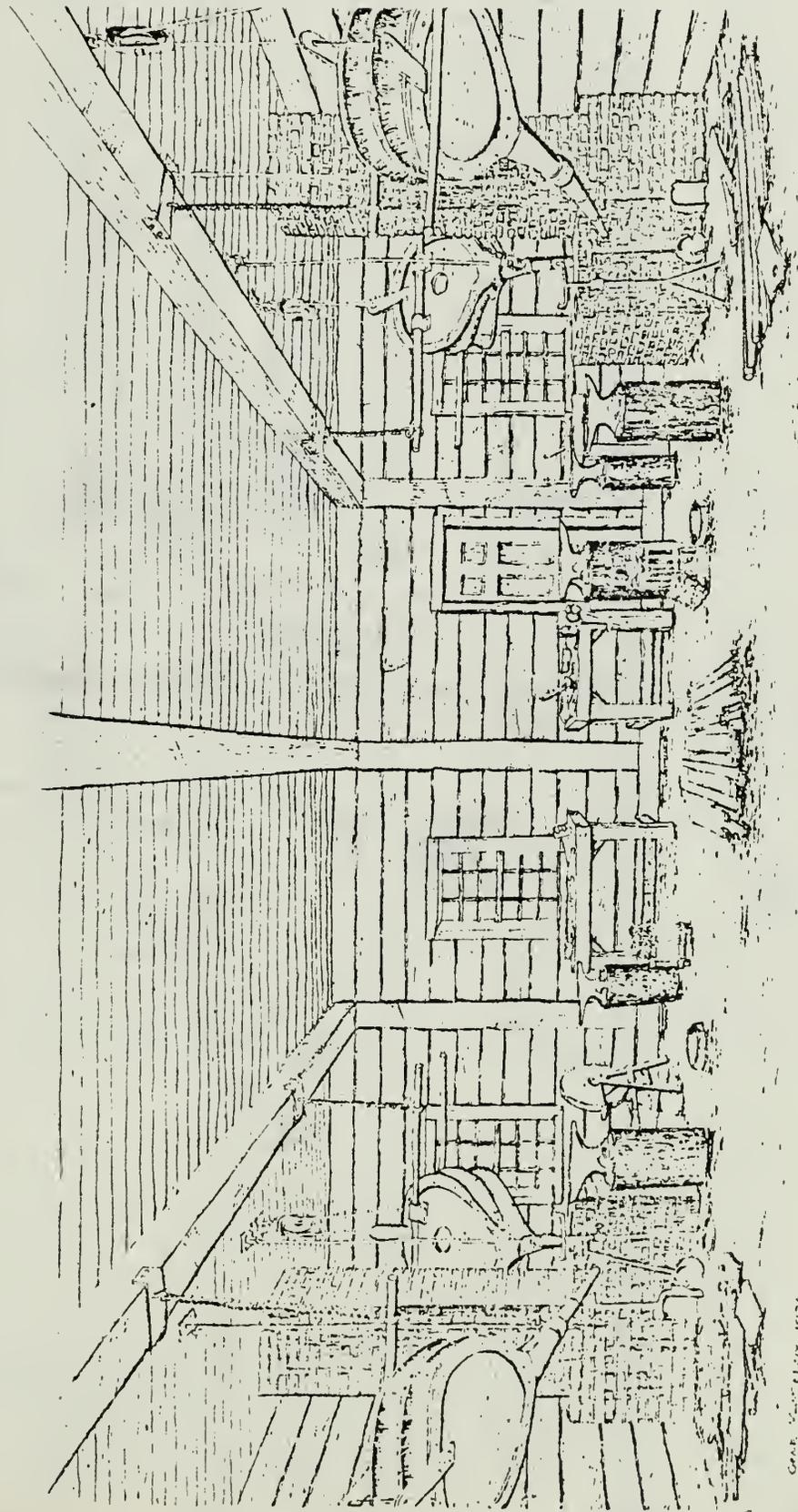


-- Historical archaeological reconstruction of the Second Blacksmith Shop exterior

PLATE 2

Historical Archaeological Reconstruction
of Second Blacksmith Shop Interior

Historical archaeological reconstruction of the second blacksmith shop interior



GRACE S. WOODRUFF 1873

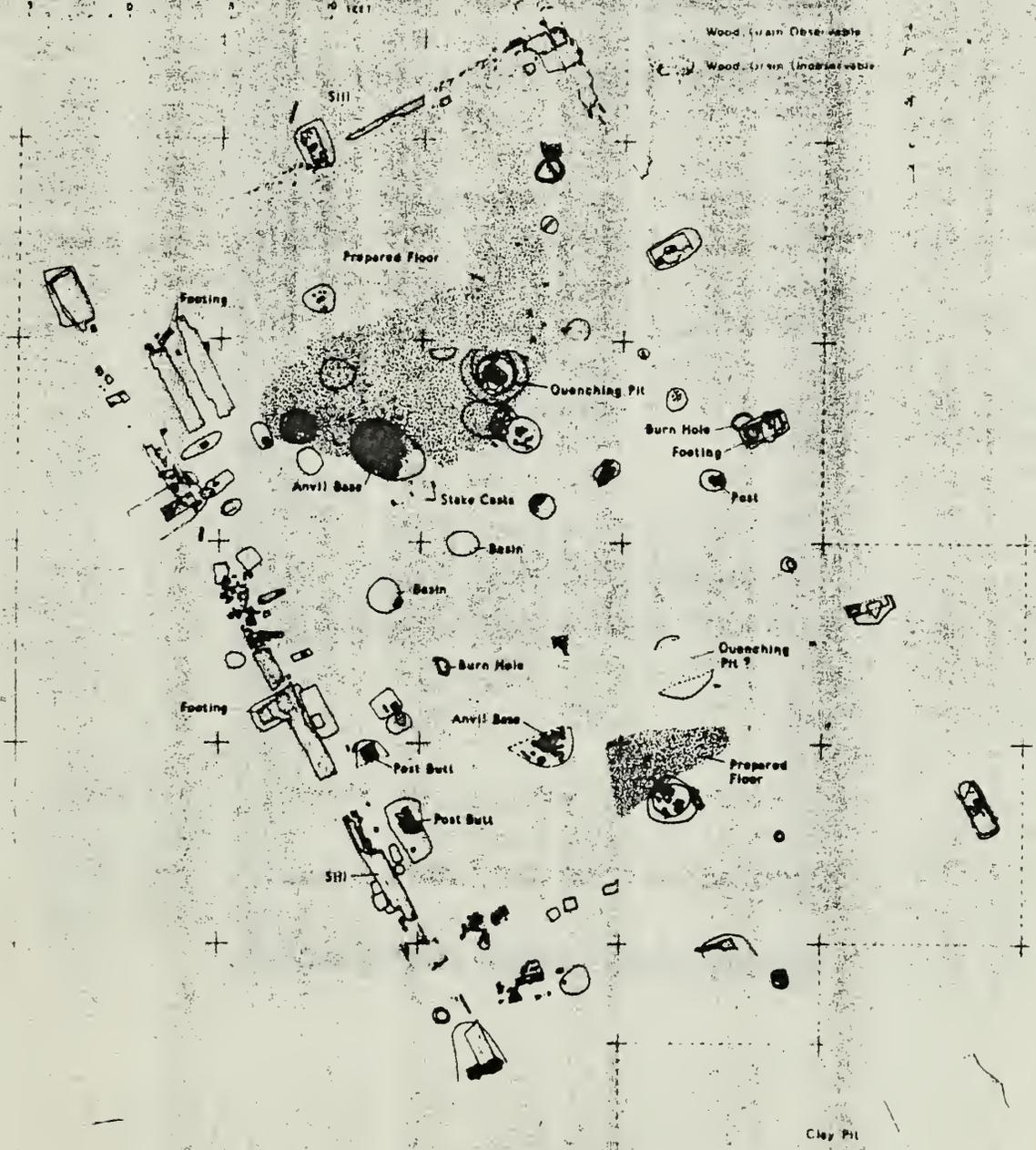
PLATE 3

Locations and Identifications
of In Situ

Hudson Bay Company Features for Blacksmith Shop

Fort Vancouver Blacksmith Shop HBC Features

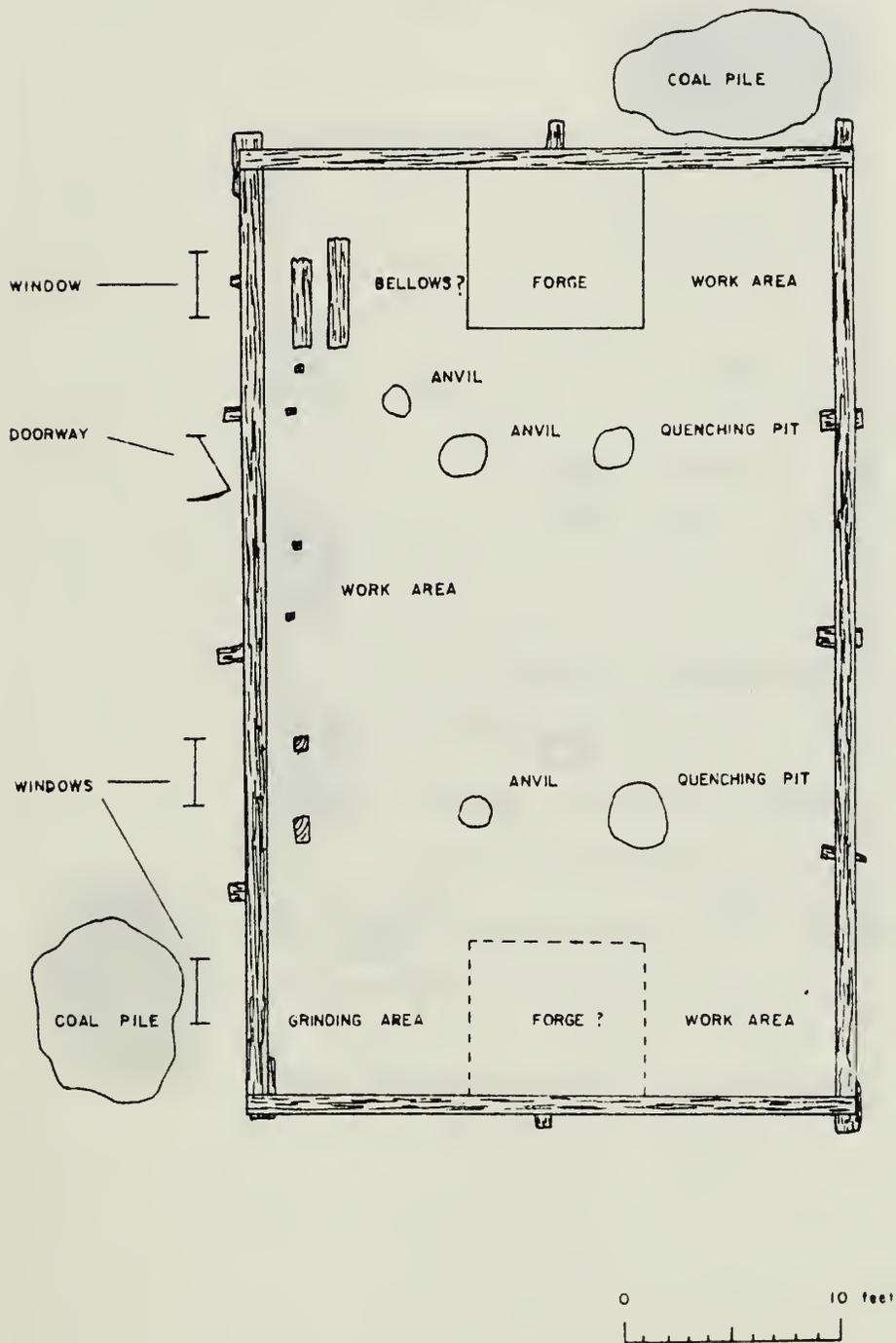
1974 Field Excavation



Locations and identification of in situ HBC features for the Blacksmith Shop.

PLATE 4

Interpretive Plan of the
In Situ Hudson Bay Company
Features for the Blacksmith Shop



Interpretive floor plan of the in situ HBC Features for the Blacksmith Shop.

PLATE 5

Hypothetical Reconstructed Floor Plan

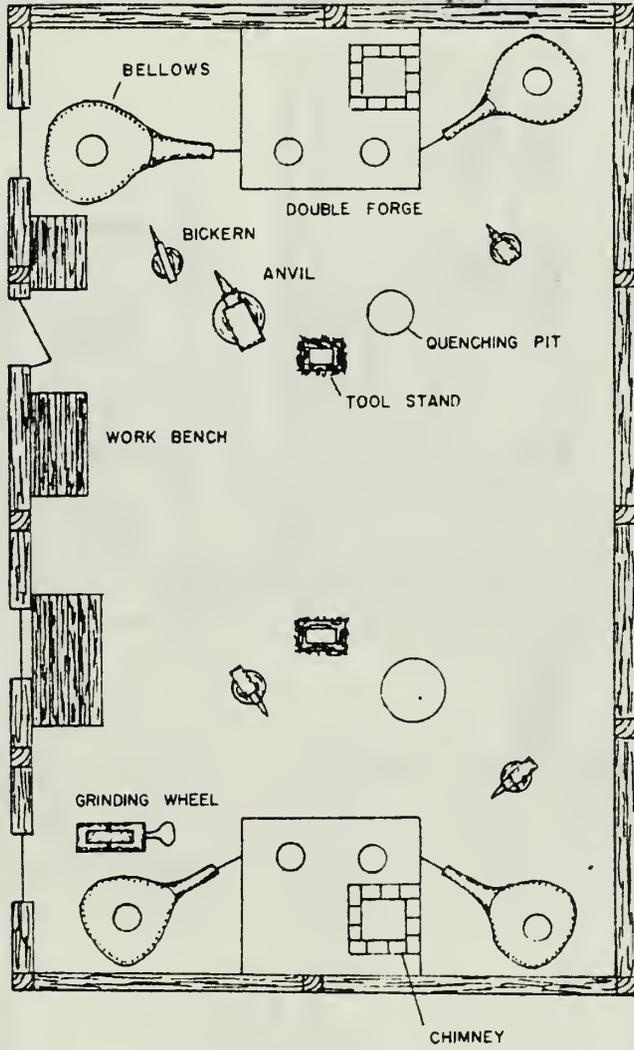
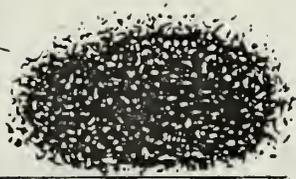
for the Blacksmith Shop

Based on Currently Available (1976)

Historical Accounts

Together with In Situ Archaeological Remains

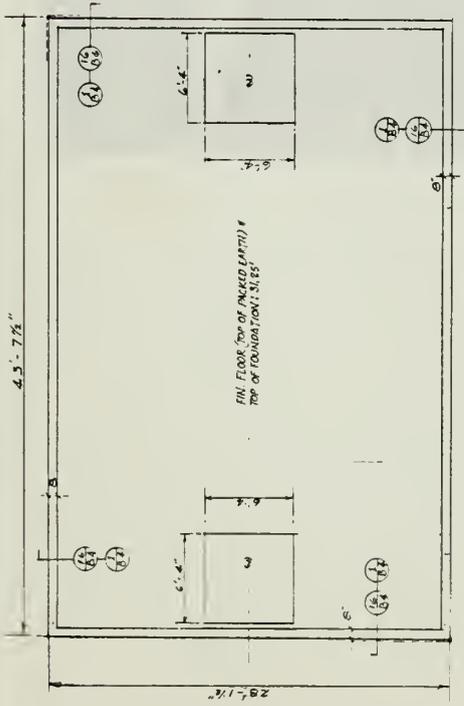
COAL



Hypothetical reconstructed floor plan for the Blacksmith Shop (based upon currently available historical accounts together with in situ archaeological remains).

PLATE 6

National Park Service Blueprints
for
Reconstructed Blacksmith Shop



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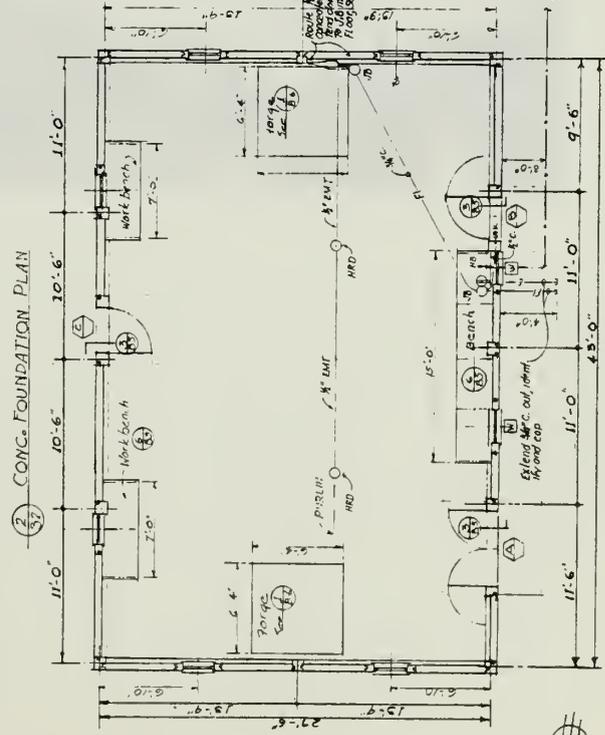


PLATE 7

View of Forge at Lower Fort Garry, Manitoba

note arrangement of tongs

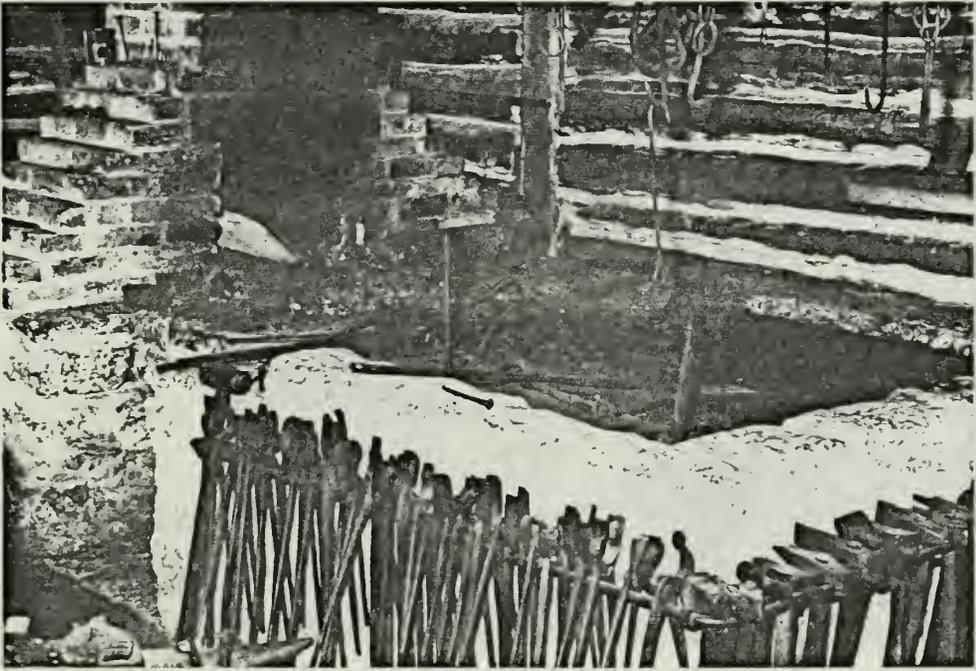


PLATE 8

Side View of Forge in Blacksmith Shop
at Lower Fort Garry National Historical Park
Winnipeg, Manitoba

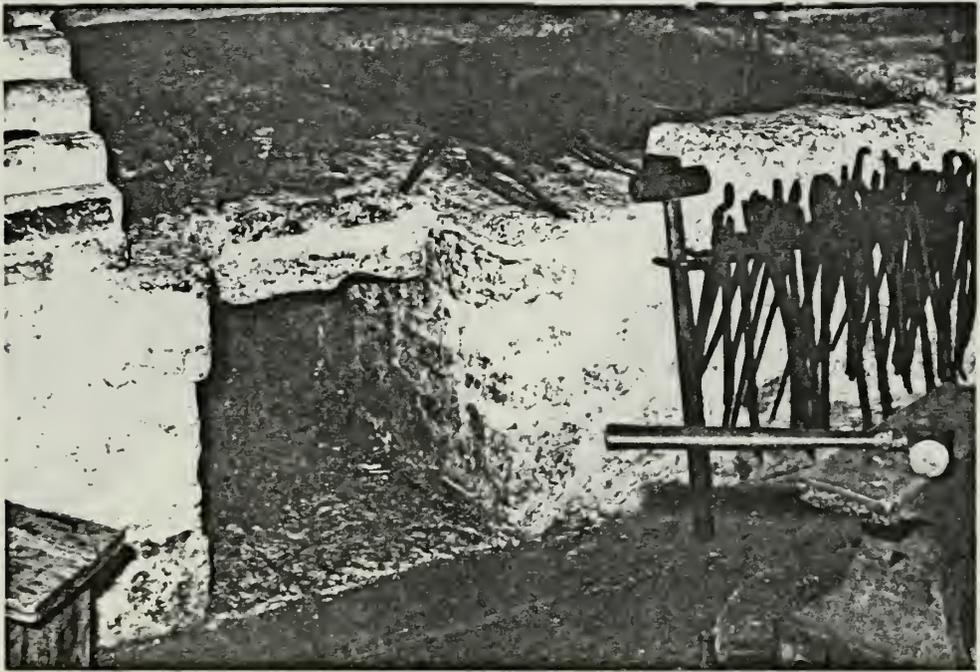


PLATE 9

Close-up Detail of
Forge at Lower Fort Garry

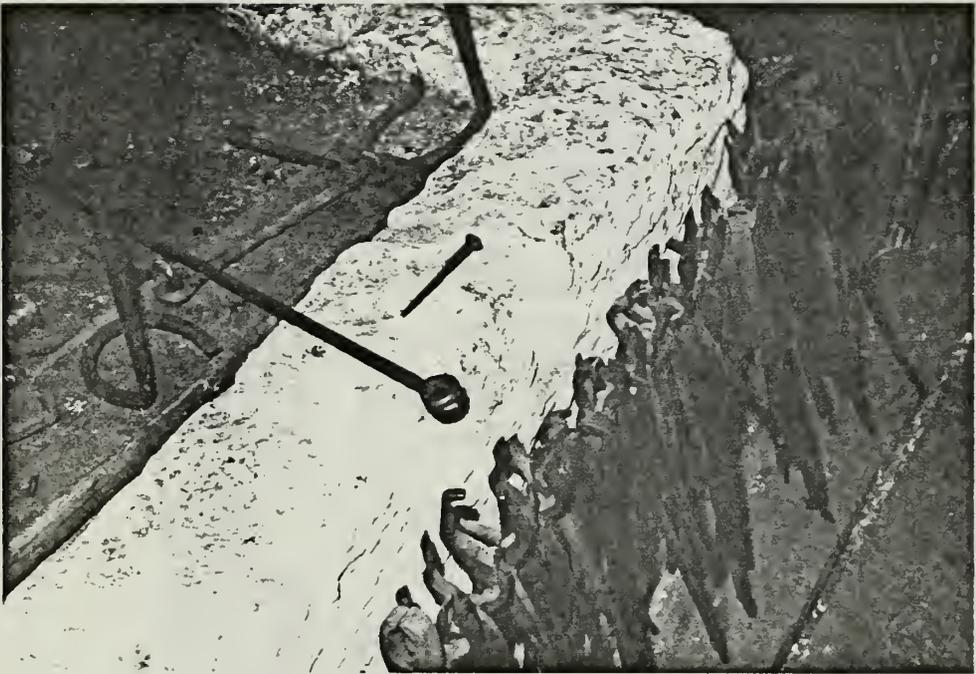


PLATE 10

Brick Forge at
Lower Fort Garry

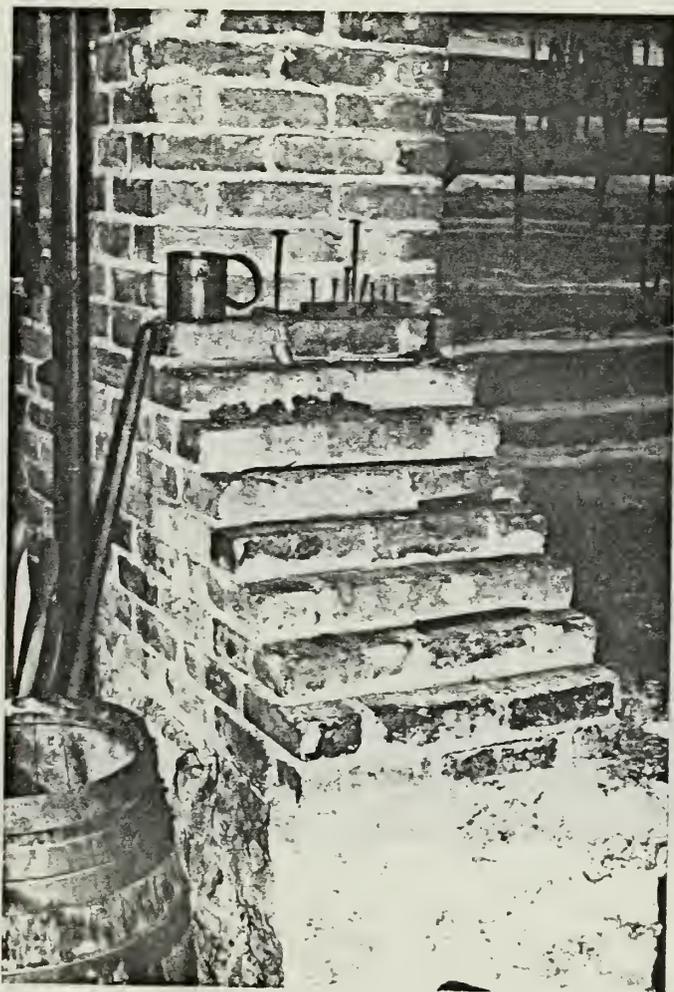


PLATE 11

Iron Blacksmith Tongs in
Blacksmith Shop at Lower Fort Garry

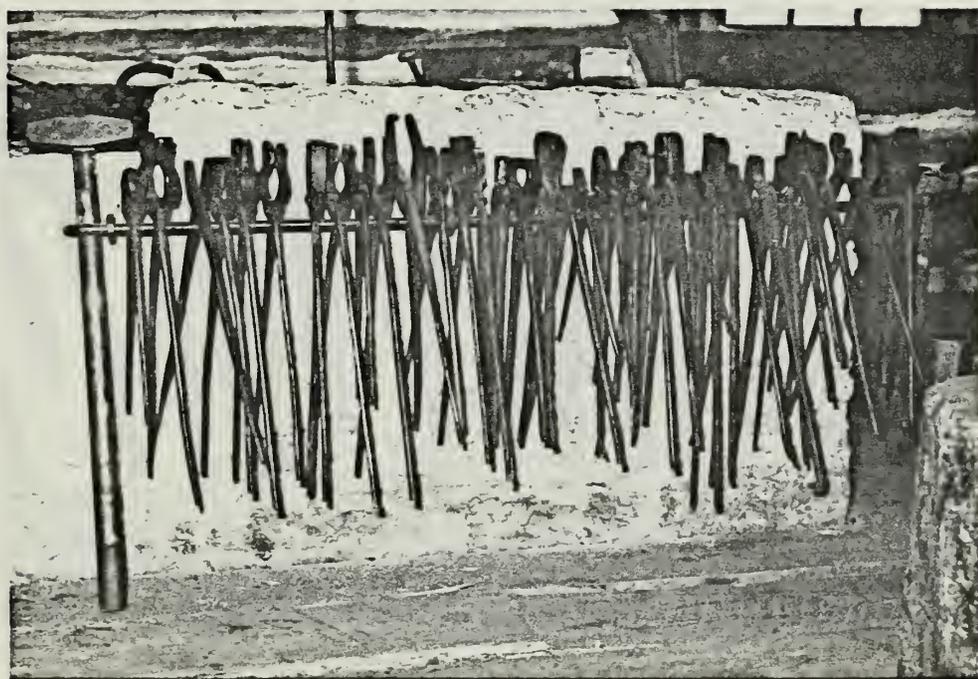


PLATE 12

Blacksmith's Hammers in
Blacksmith Shop at Lower Fort Garry



PLATE 13

Anvil in Blacksmith Shop at Lower Fort Garry

Note: the anvil block and the arrangement of tools on the block

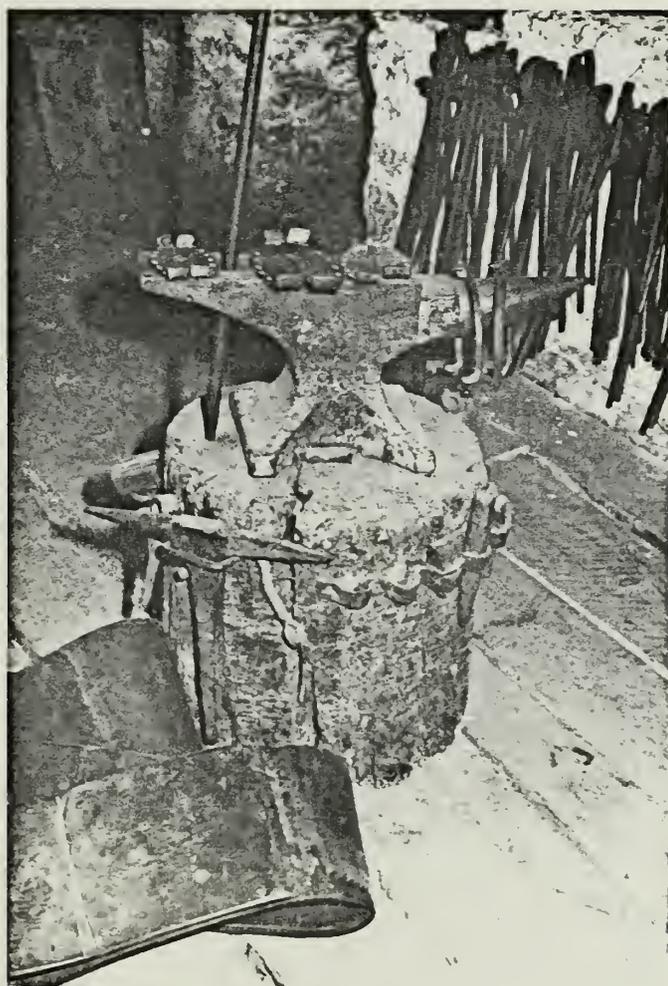


PLATE 14

Another Anvil and Block
in Blacksmith Shop at Lower Fort Garry



PLATE 15

Leg Vise

in Blacksmith Shop at Lower Fort Garry

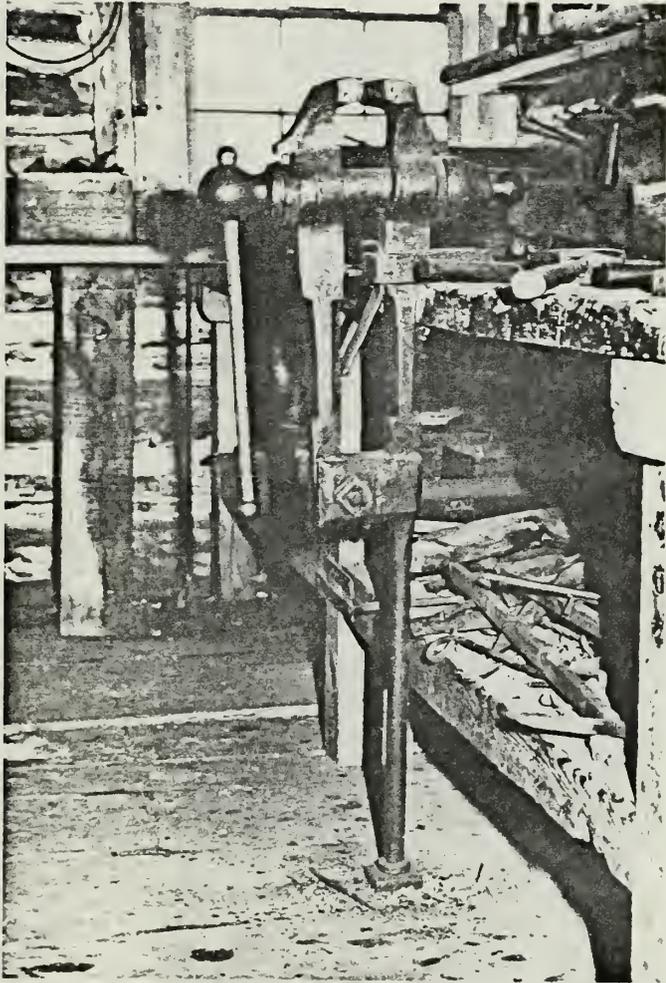


PLATE 16

19th century drill press in
Blacksmith Shop at Lower Fort Garry

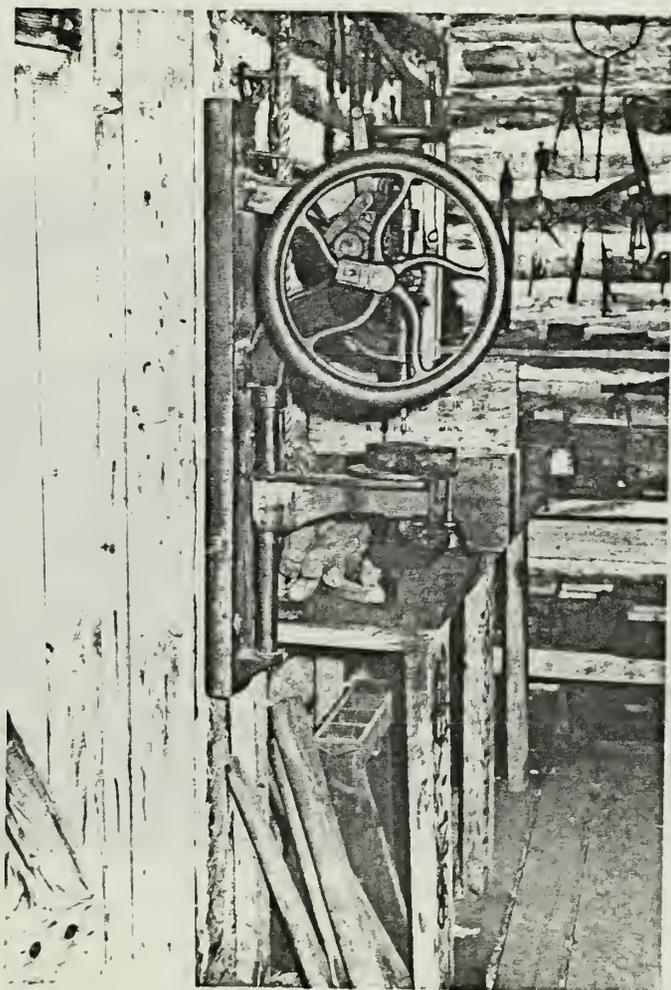
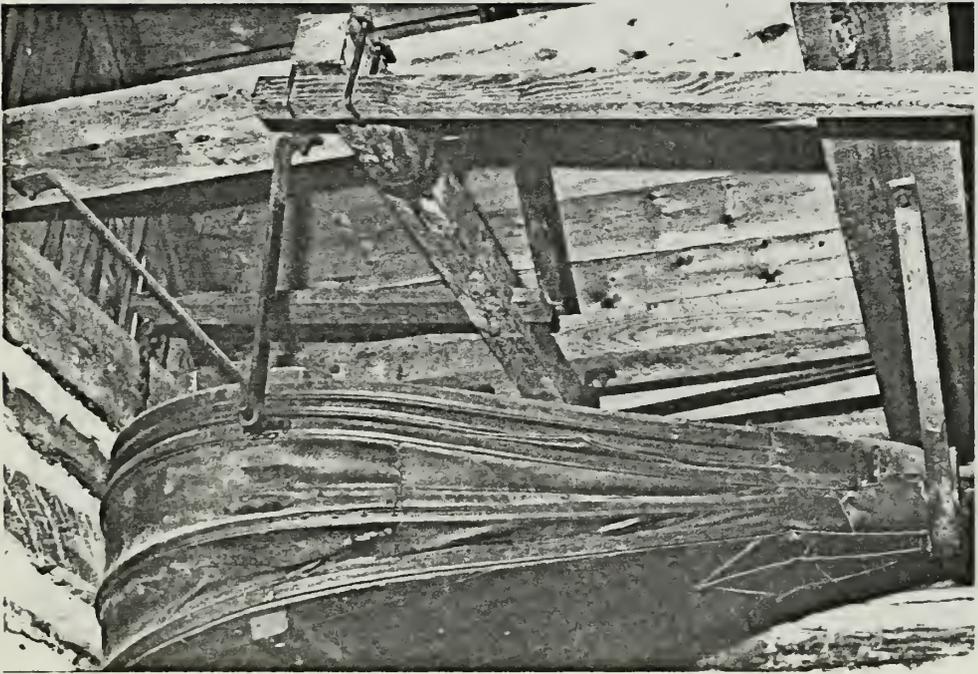


PLATE 17

Bellows in Blacksmith Shop at
Lower Fort Garry

Note: Mounting of the bellows



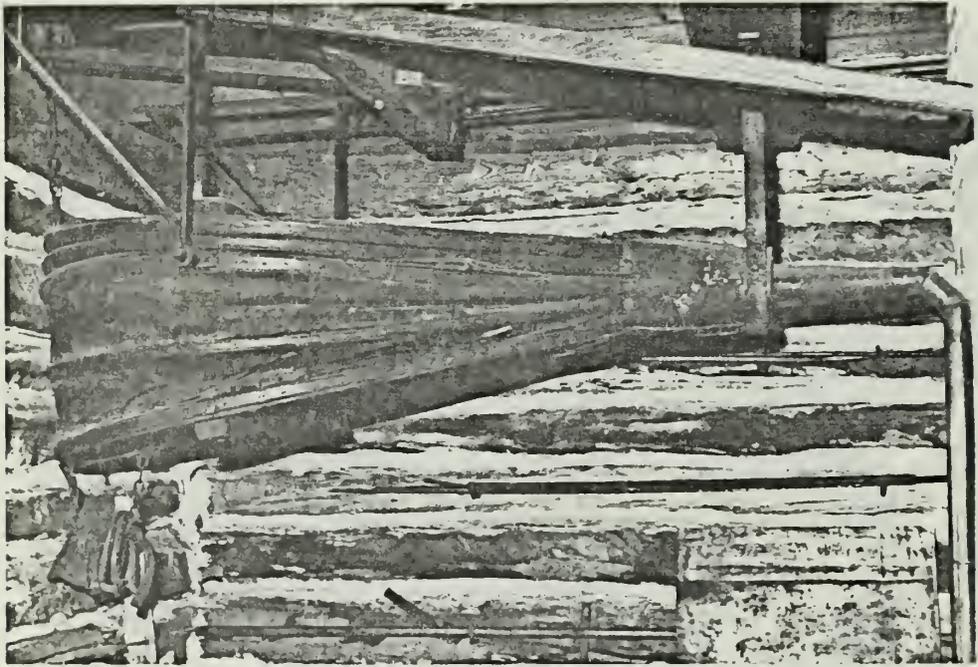


PLATE 18

Fire Shovels, Rakes, and Pokers
in Blacksmith Shop at Lower Fort Garry



PLATE 19

Blacksmith Shop at Old Fort William

Ontario

Note: The method of storage for iron stocks overhead,
the anvil blocks and benches

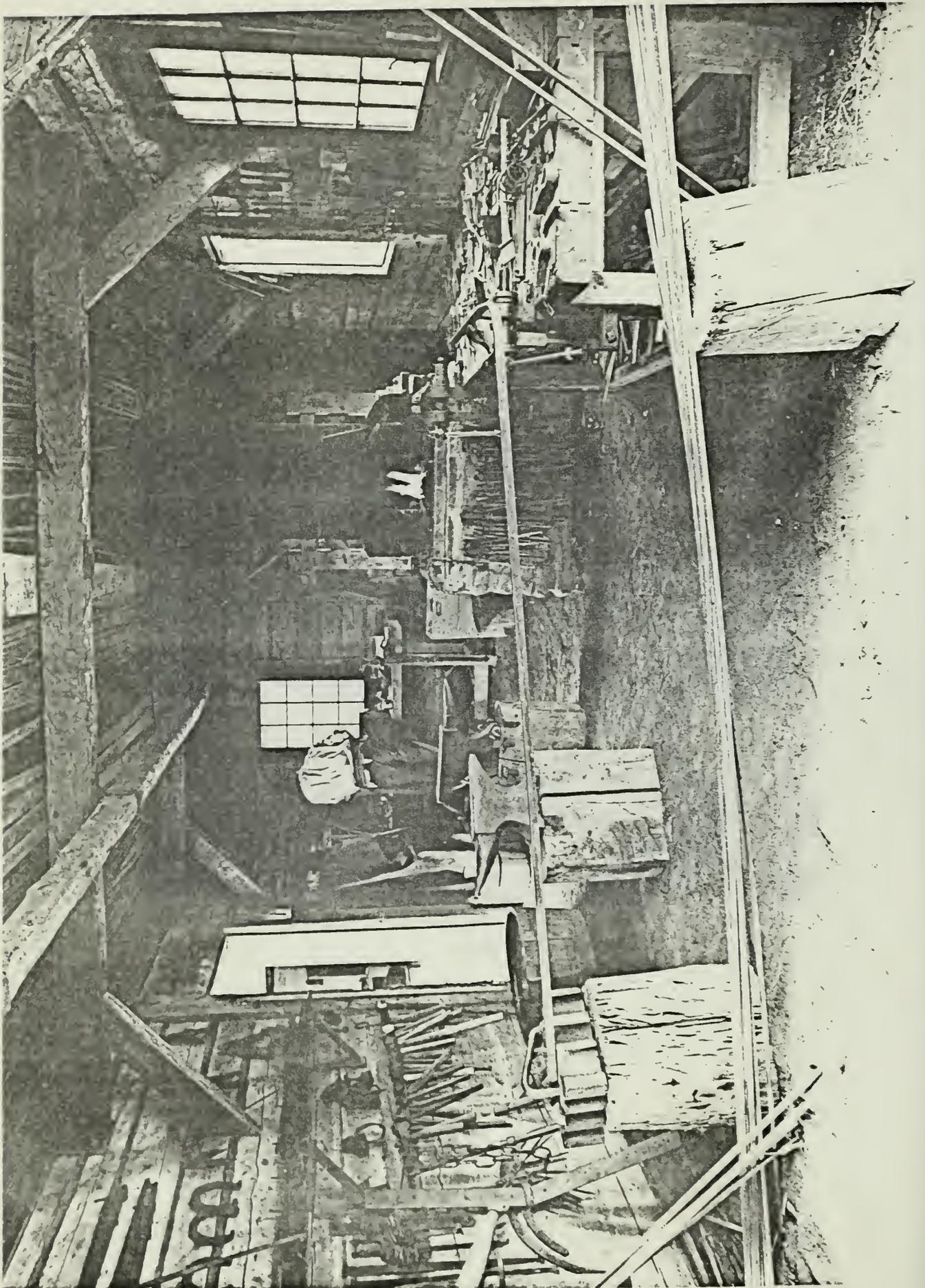
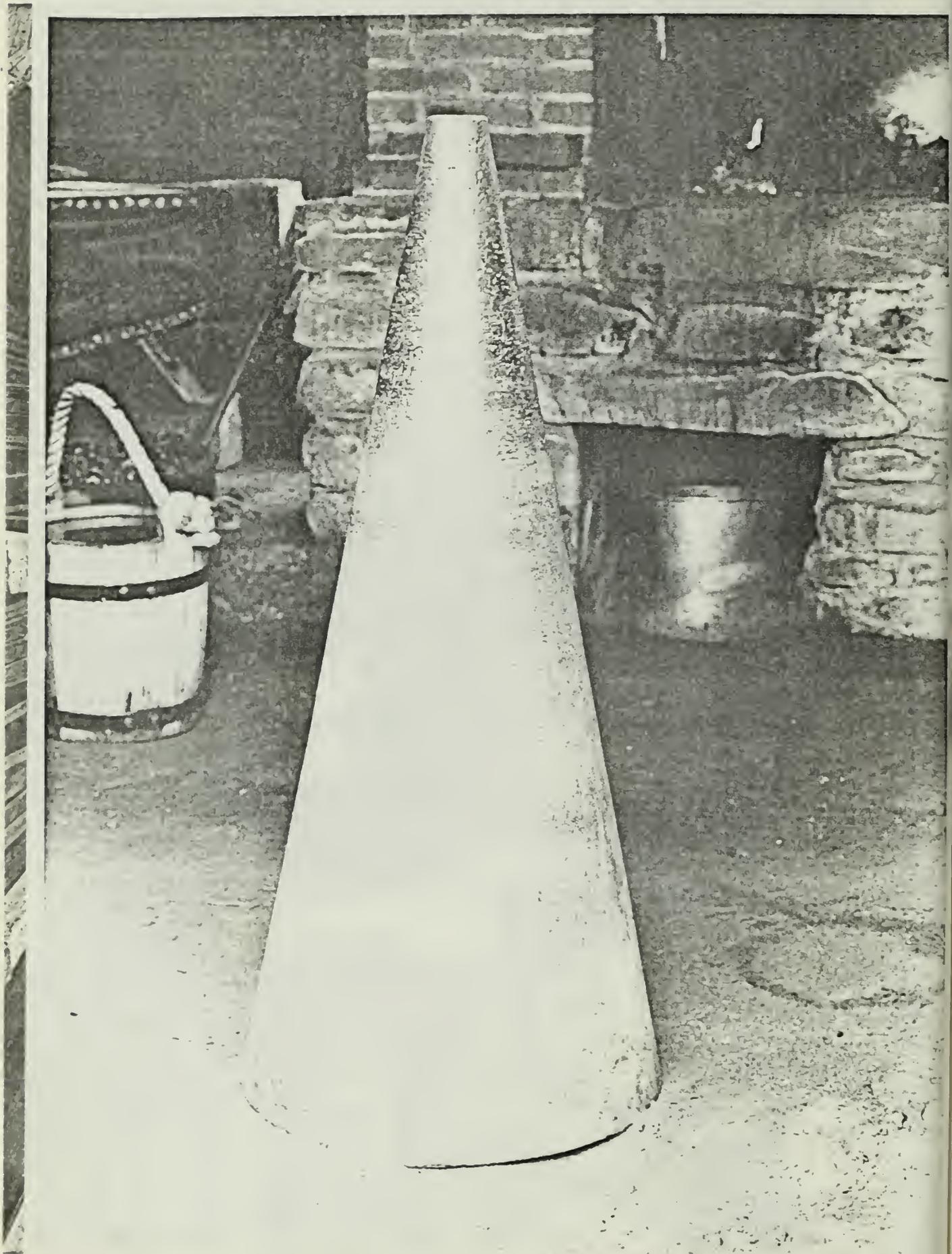


PLATE 20.

Iron Core Mandril in Blacksmith Shop
at Old Fort William

Note: Mandril was used for rounding rings; the heated stock was forged down over the core.



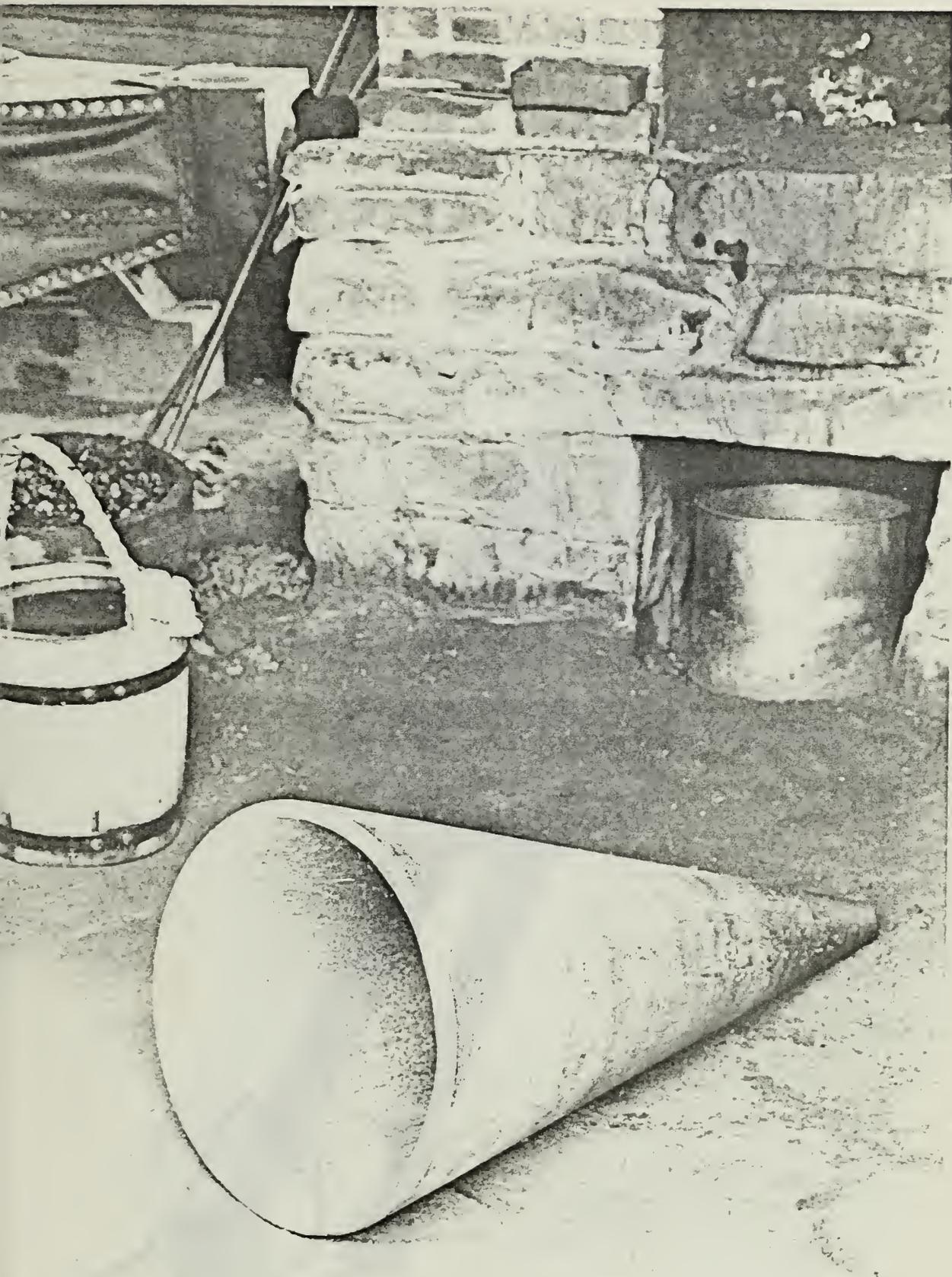


PLATE 21

Mid 19th Century Iron Screw Plate
in Blacksmith Shop at Old Fort William



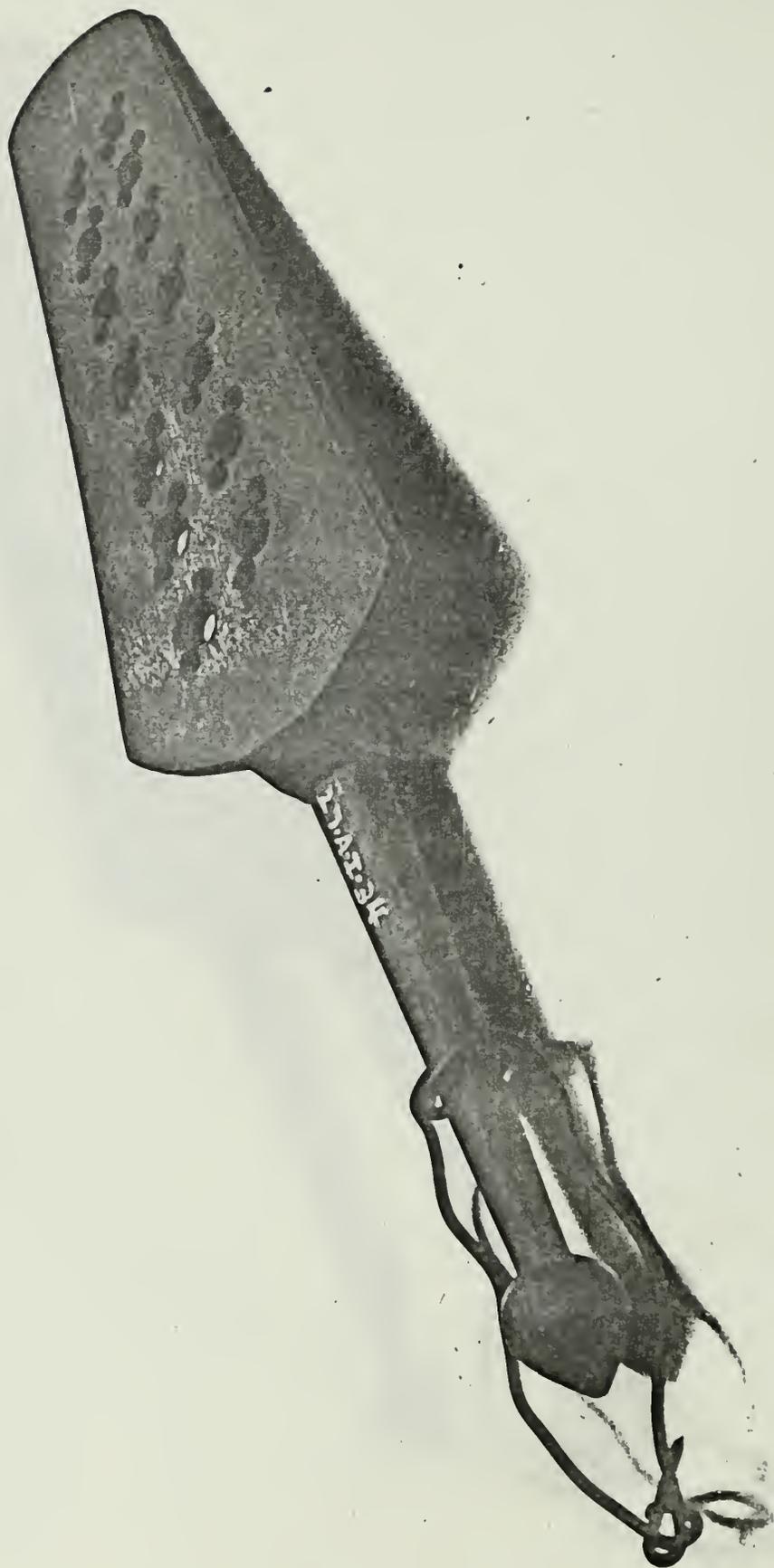
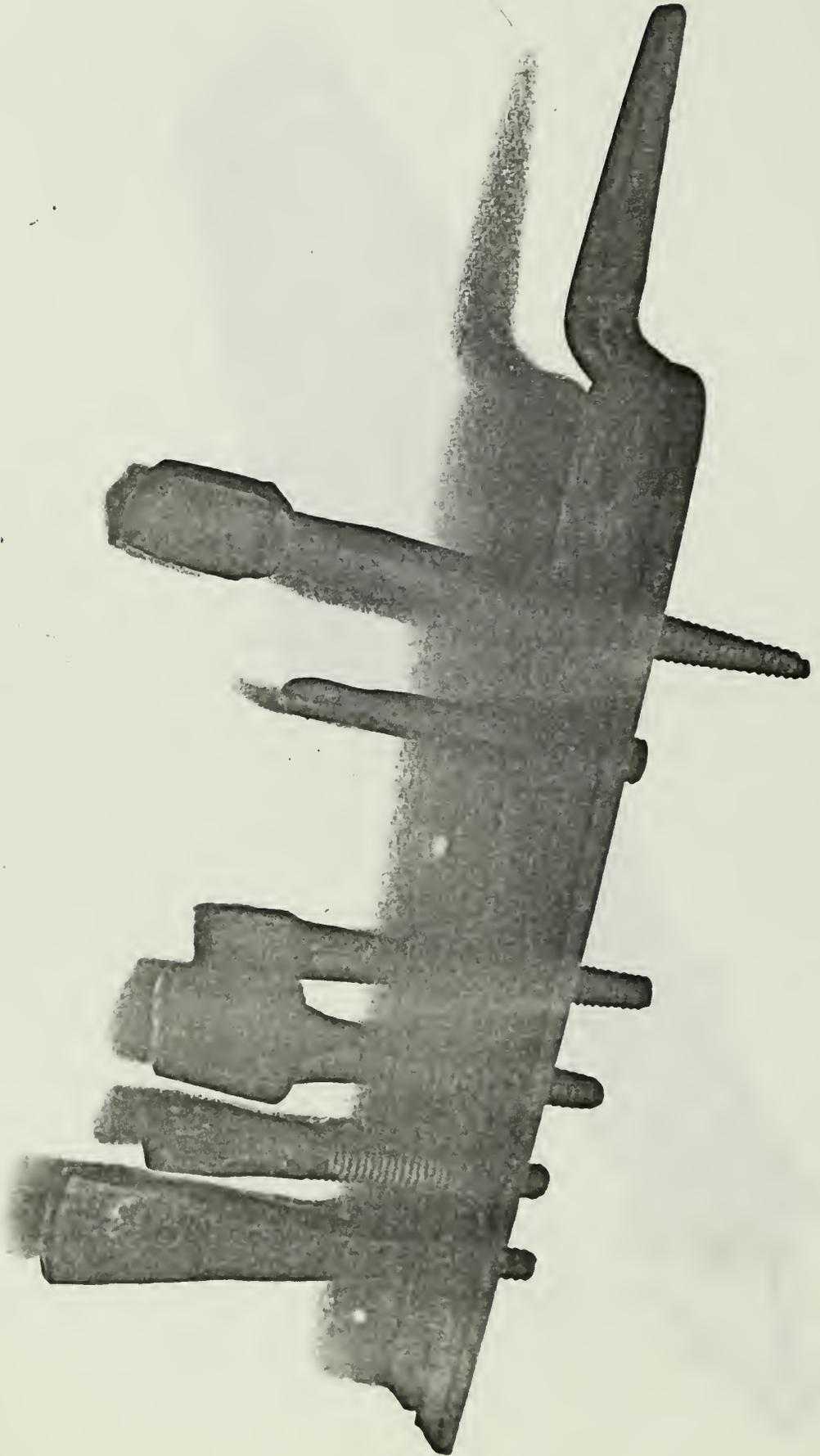


PLATE 22

Mid 19th Century Iron Screw With Taps
in Blacksmith Shop at Old Fort William



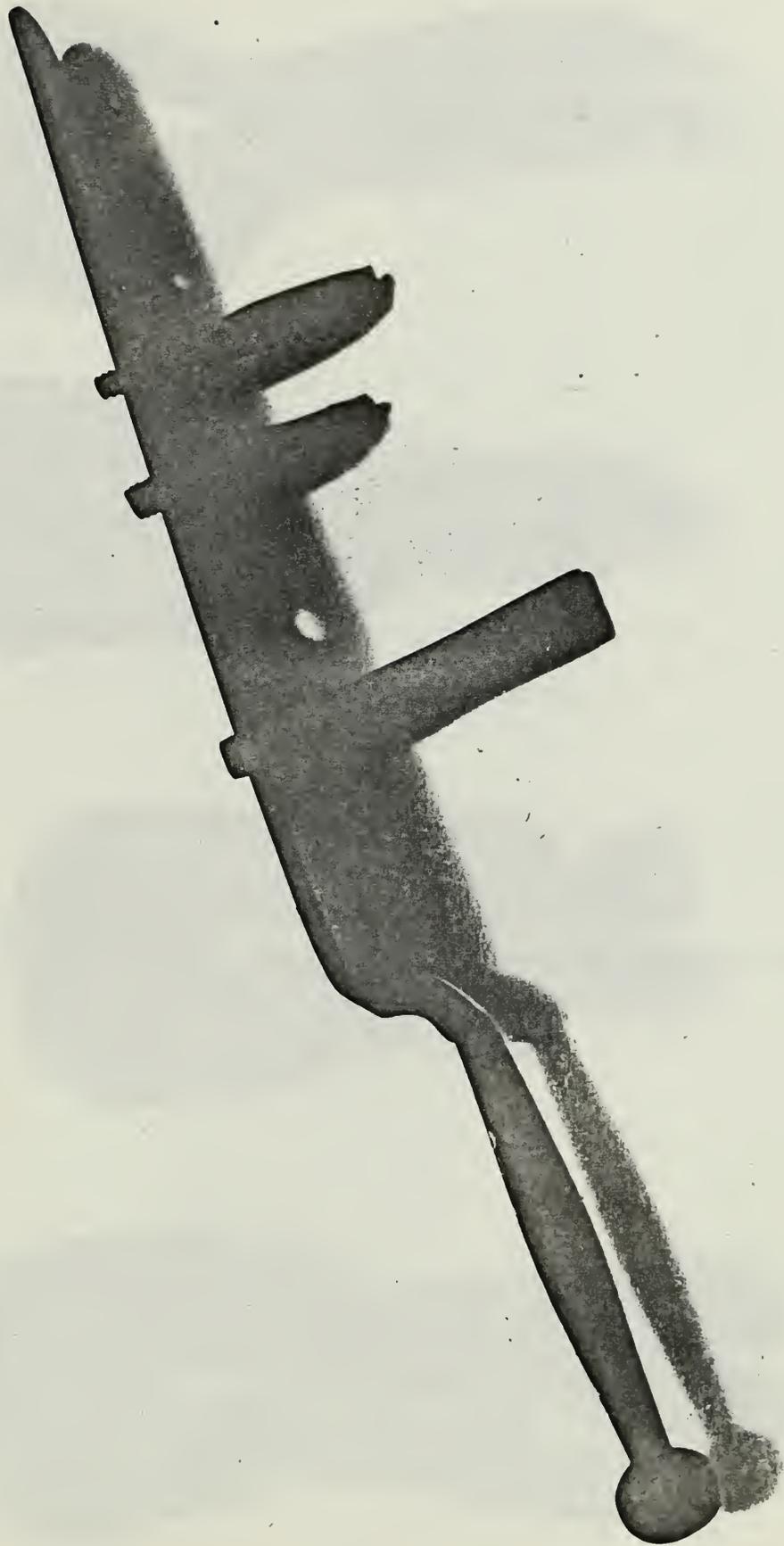
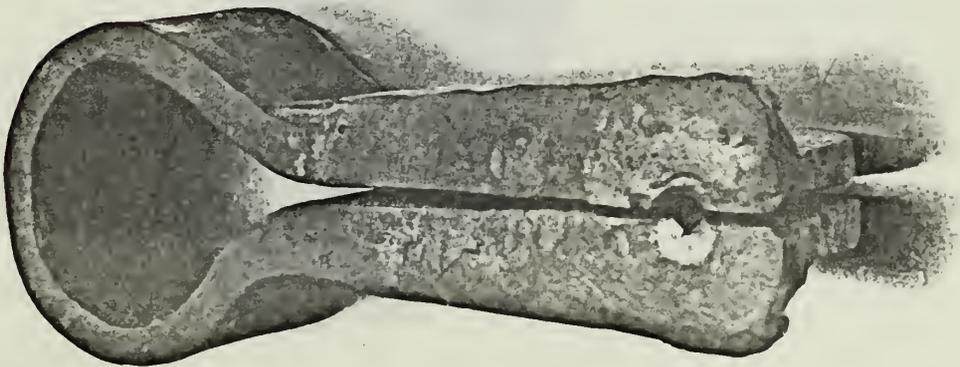
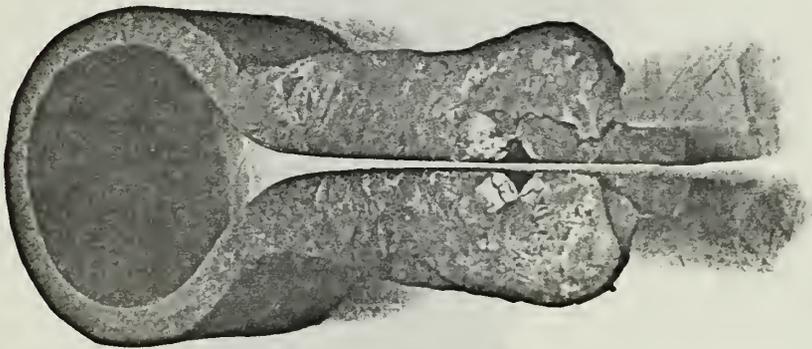
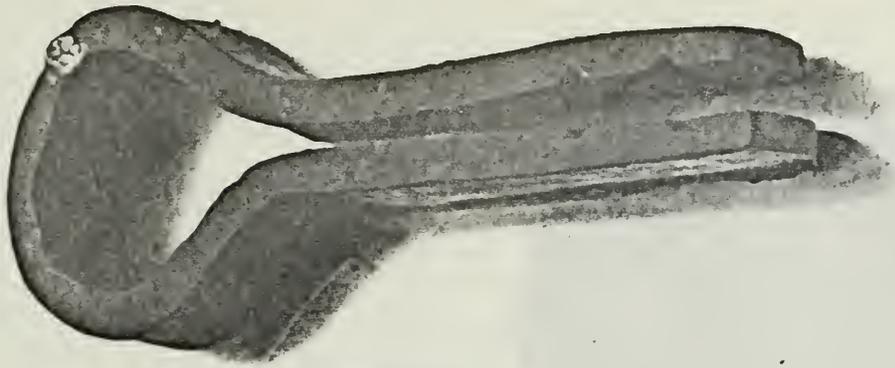
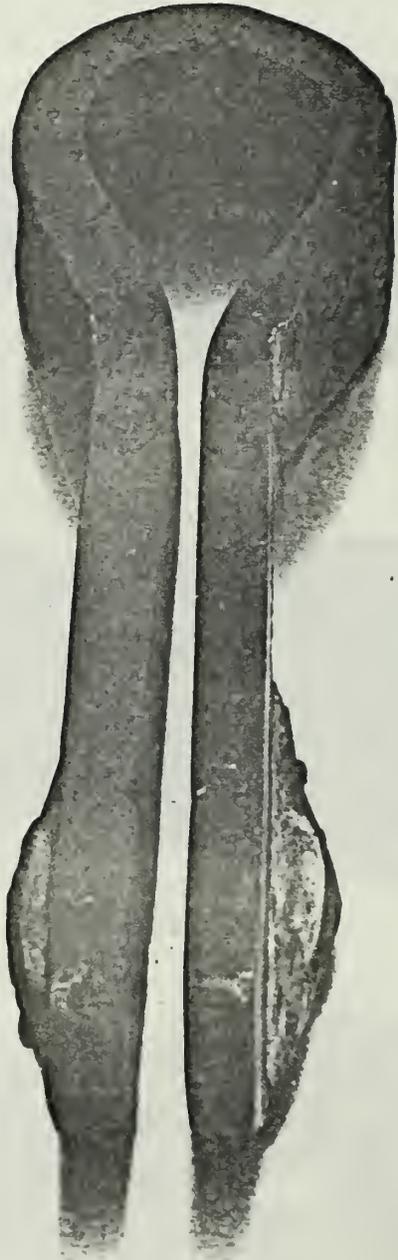


PLATE 23

Photographs of Mid 19th Century Iron Nail Headers
From Blacksmith Shop at Old Fort William

The headers were used in conjunction with a leg vise





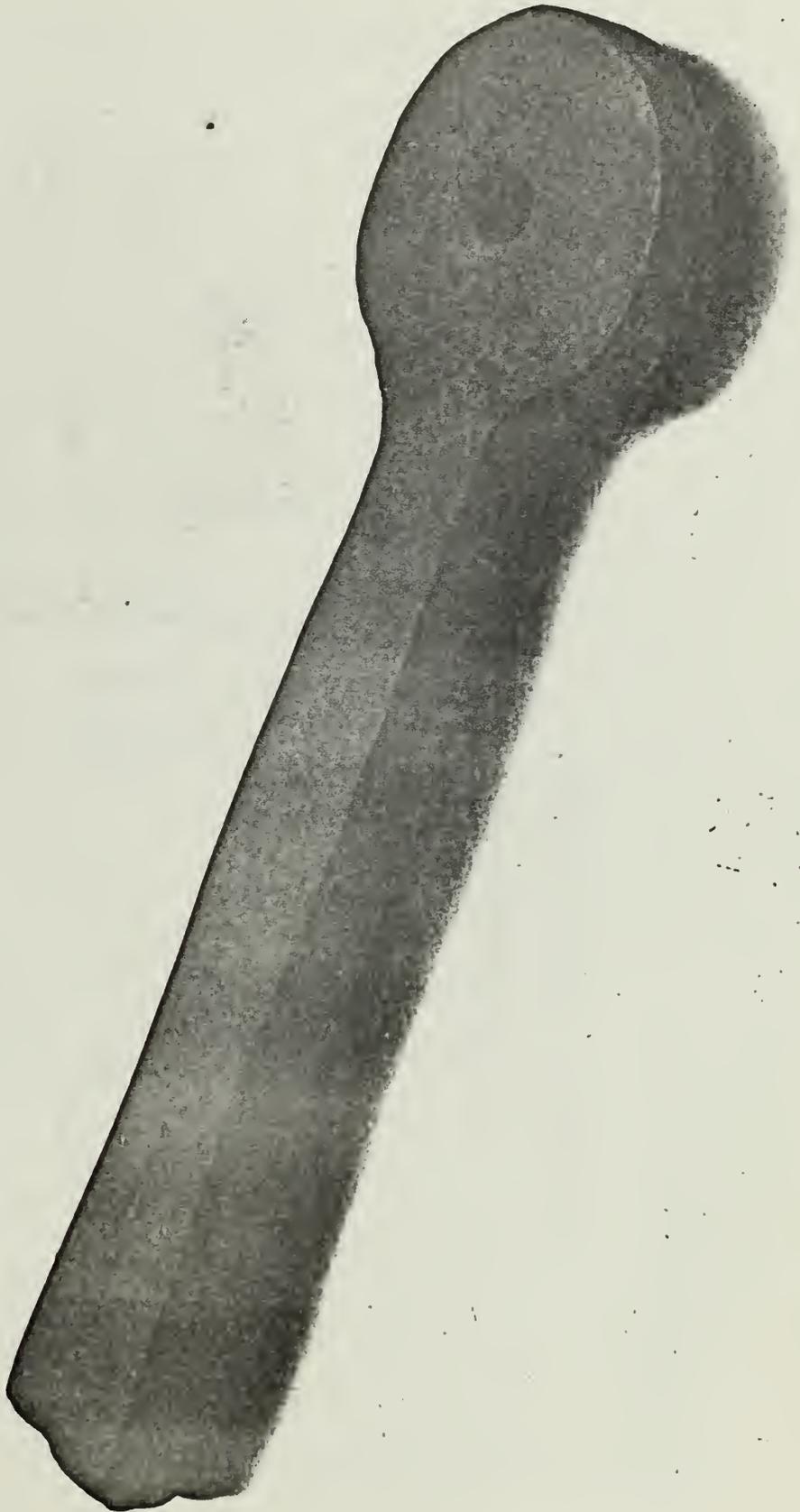
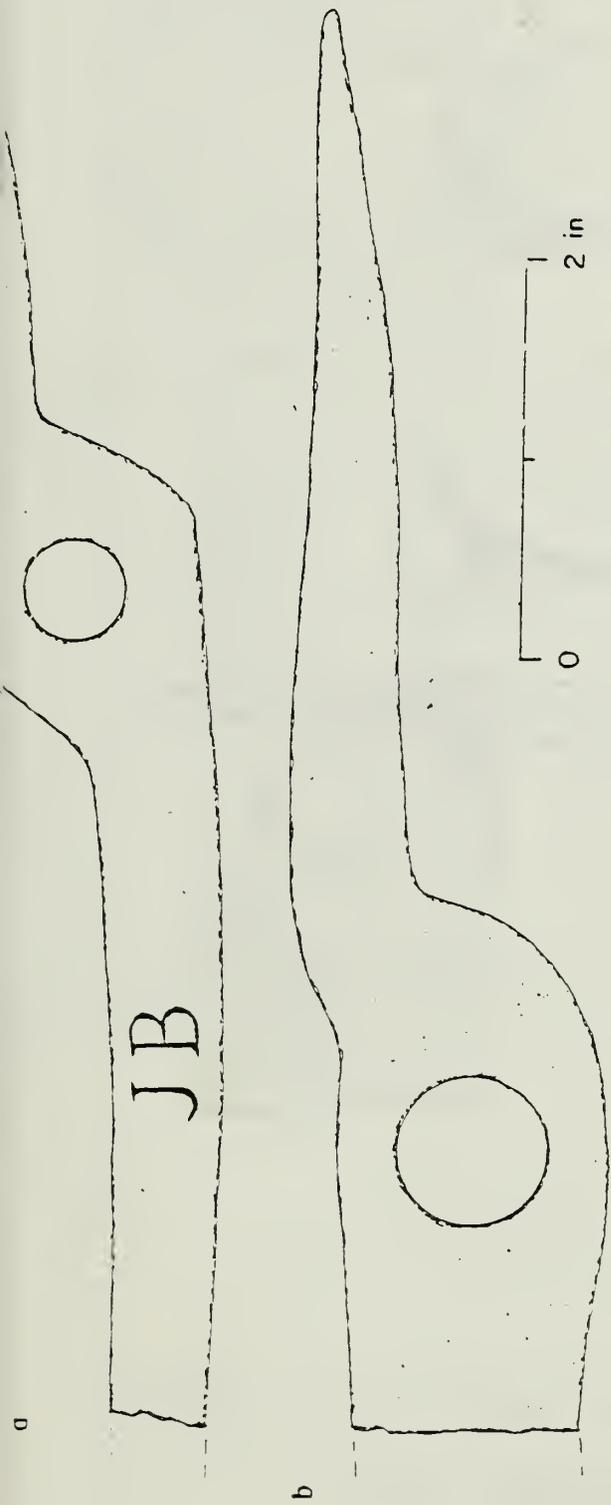


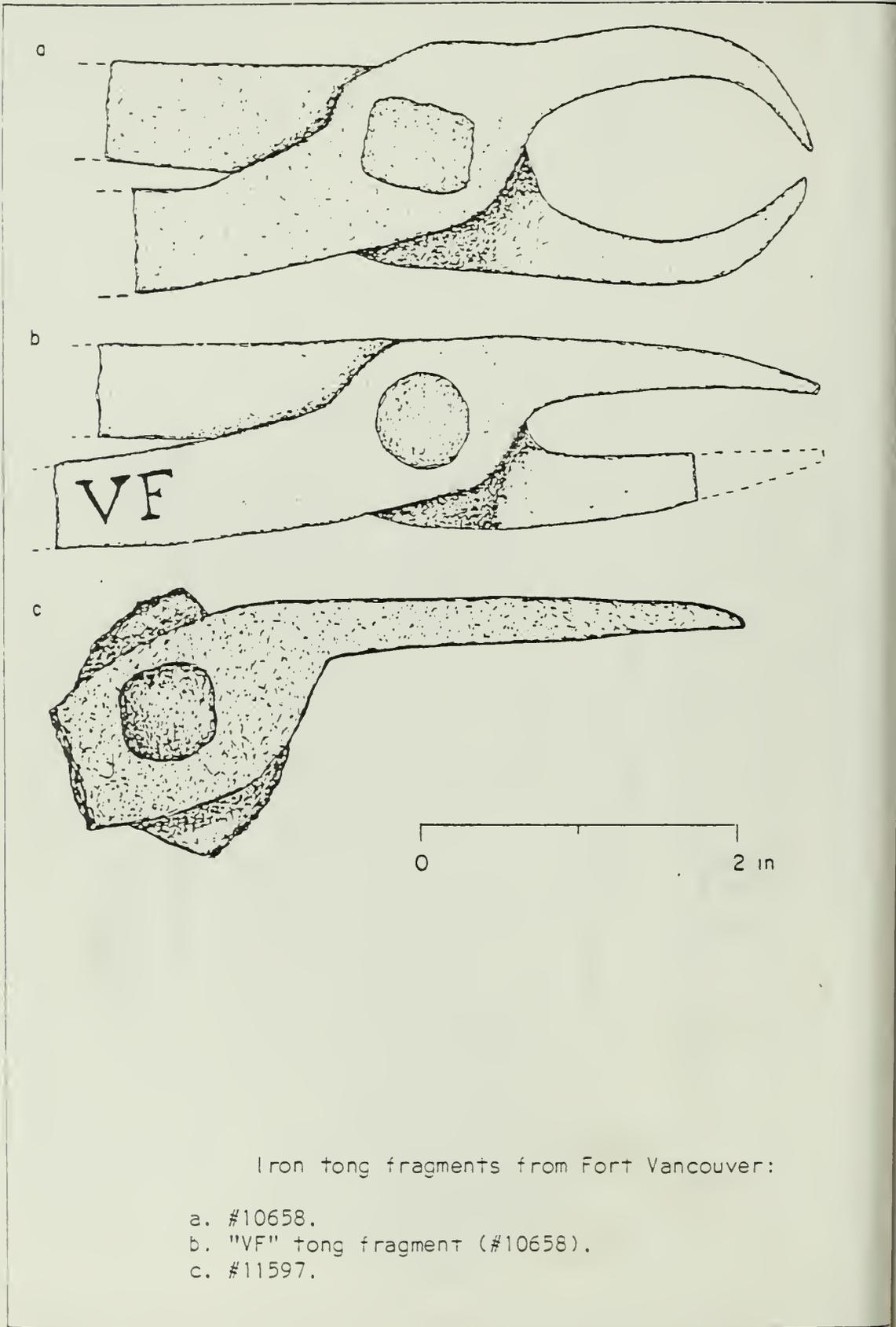
PLATE 24

Various Iron Tong Parts
Recovered from Fort Vancouver
Archaeological Excavations



- Iron tong fragments from Fort Vancouver:

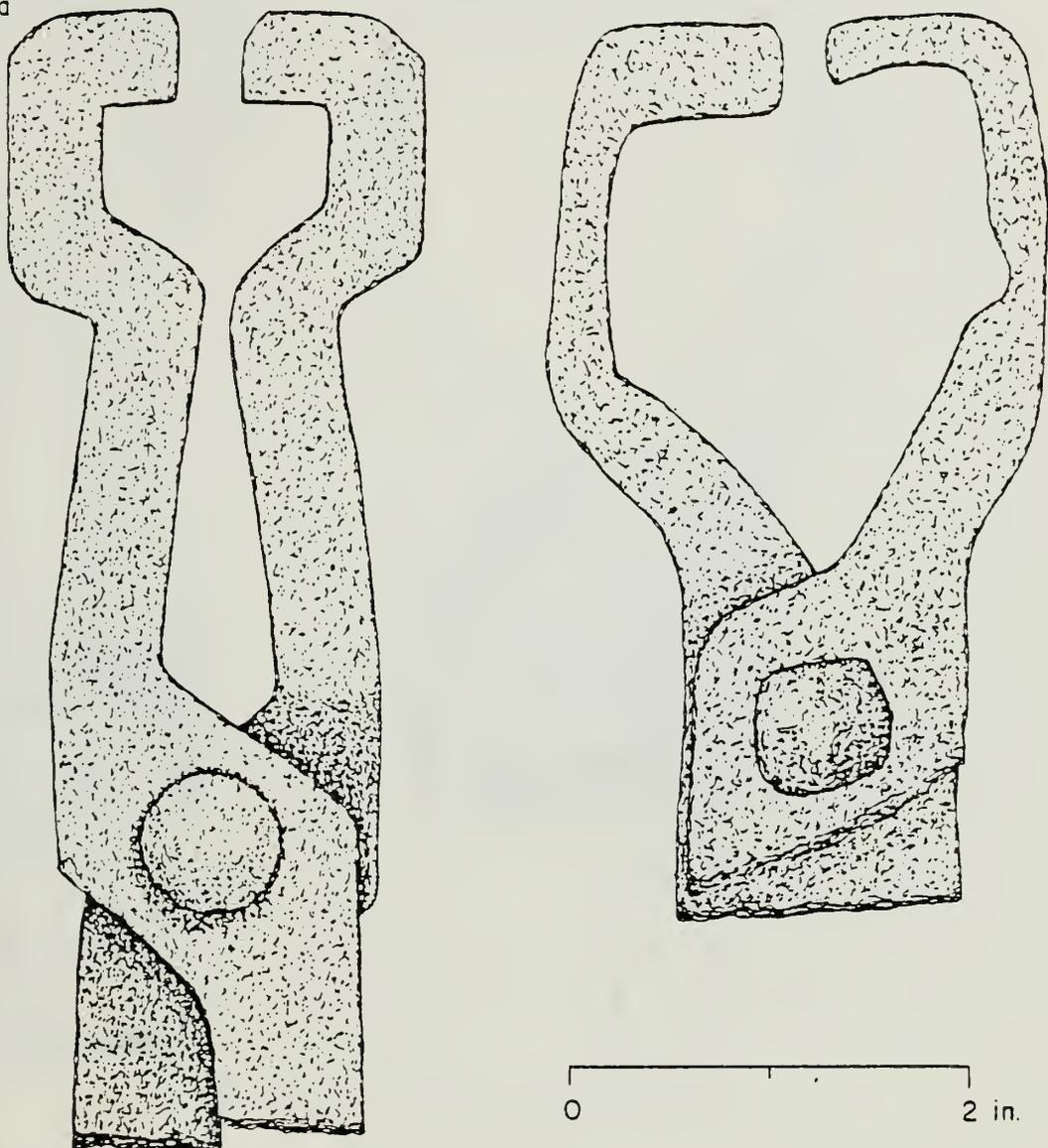
- a. "JB" tong fragment (#10658).
- b. #10658.



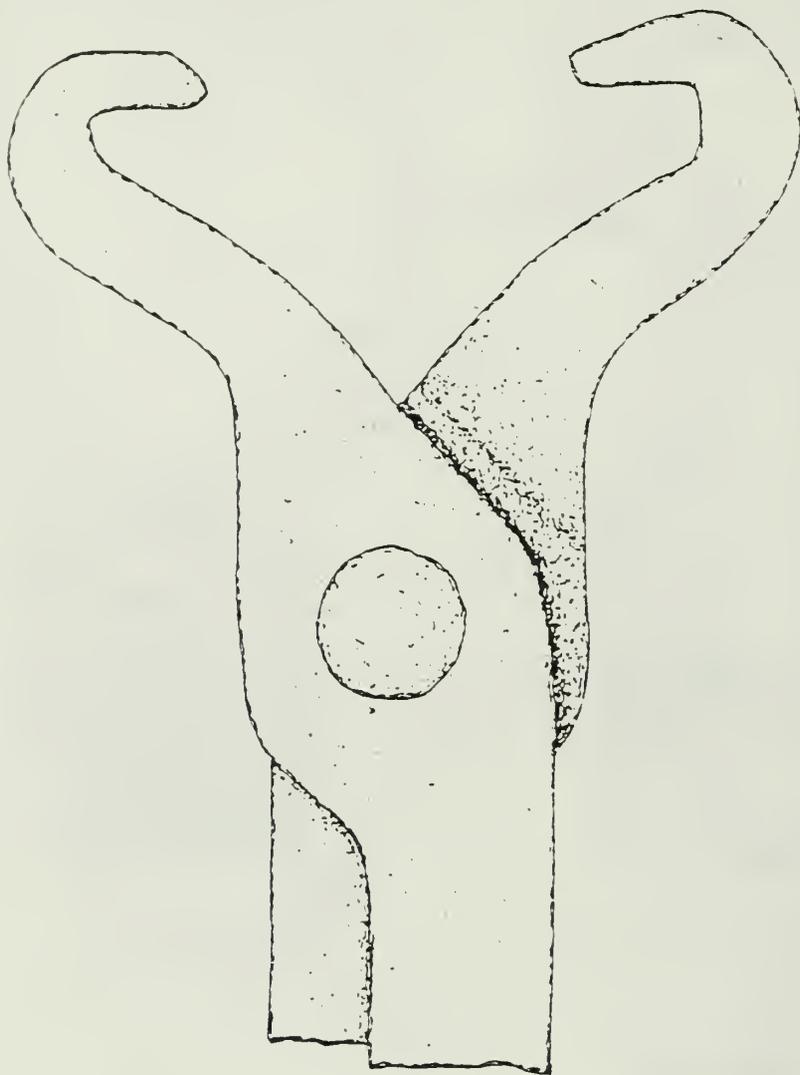
Iron tong fragments from Fort Vancouver:

- a. #10658.
- b. "VF" tong fragment (#10658).
- c. #11597.

Q

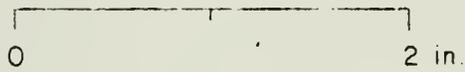
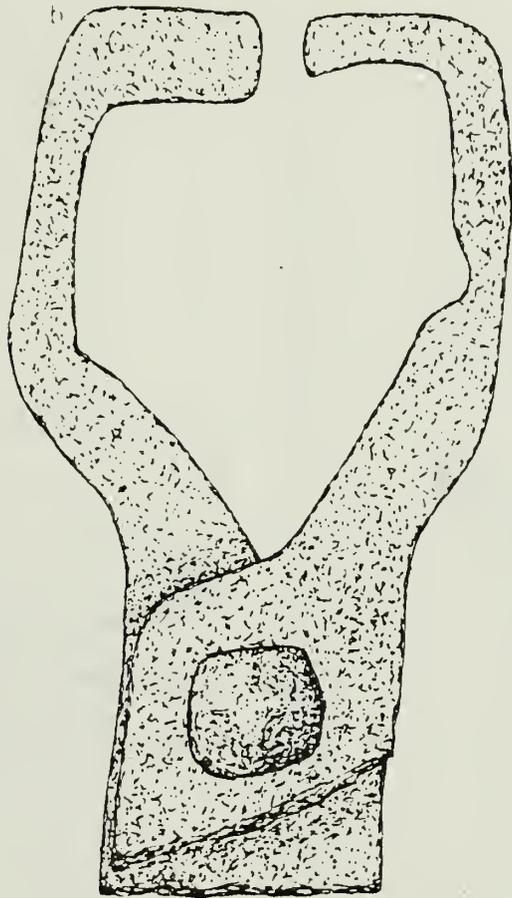
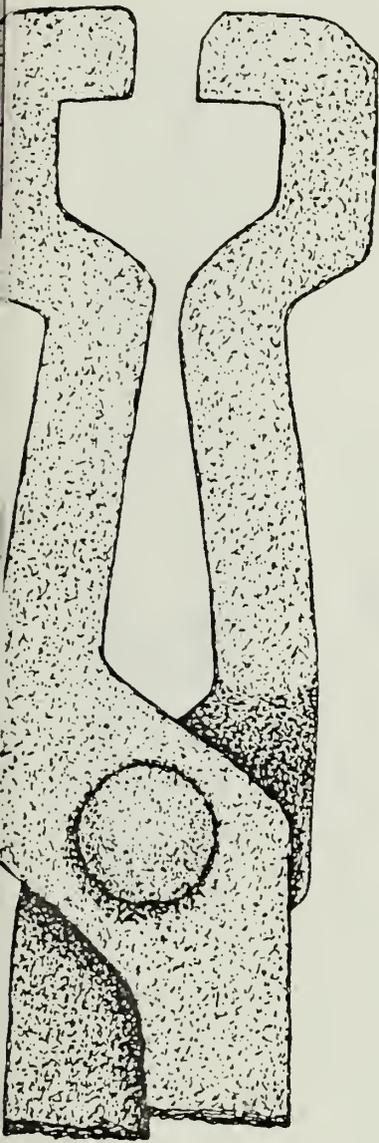


Iron tong fragments from Fort Vancouver
(both #11597).



0 2 in.

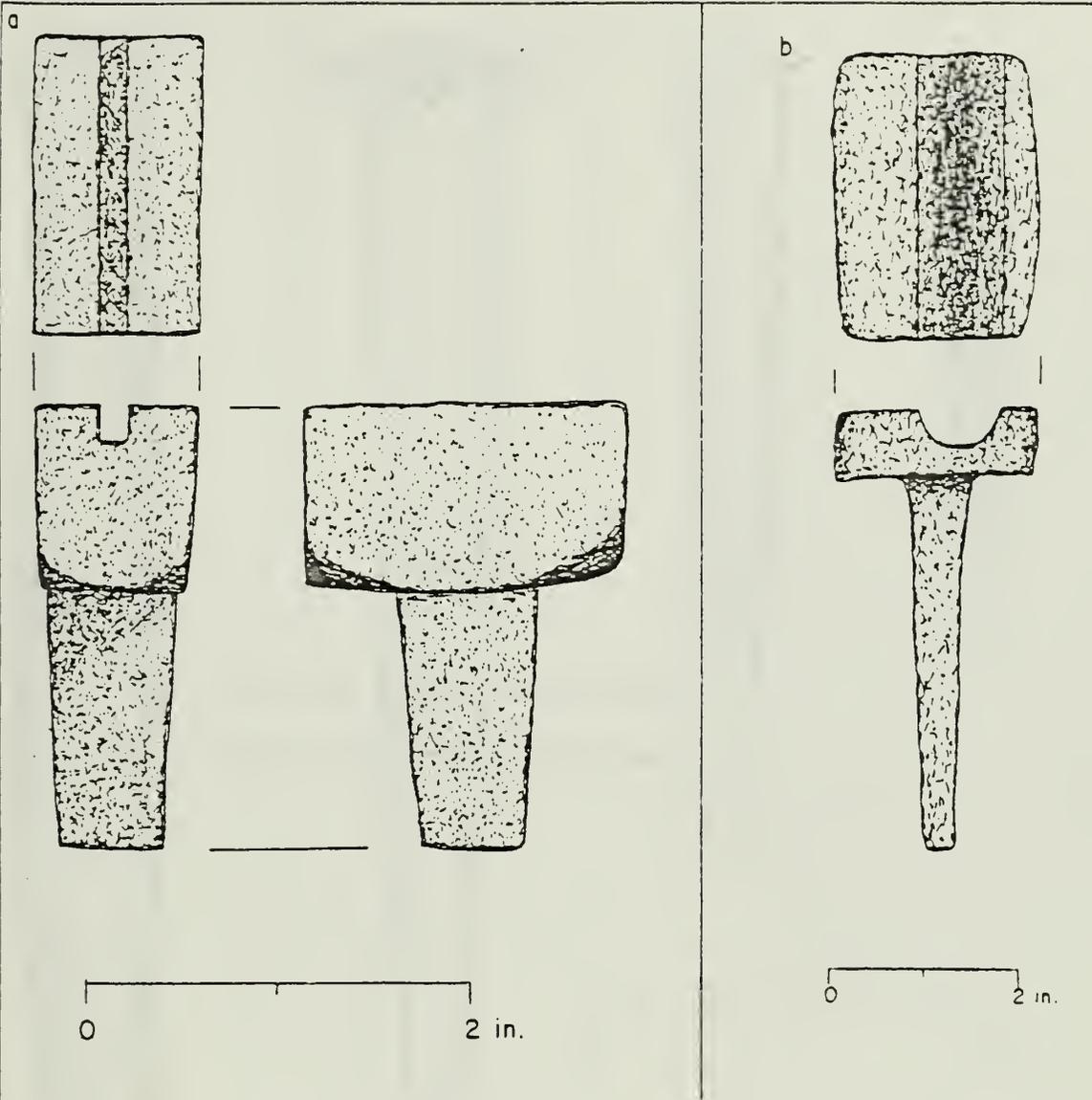
Iron tong fragment from Fort Vancouver (#10658).



Tongs from the Blacksmith Shop area: a). tongs (FOVA 3354.)
b). tongs (FOVA 34692).

PLATE 25

Iron Swages Recovered From
Fort Vancouver Excavations

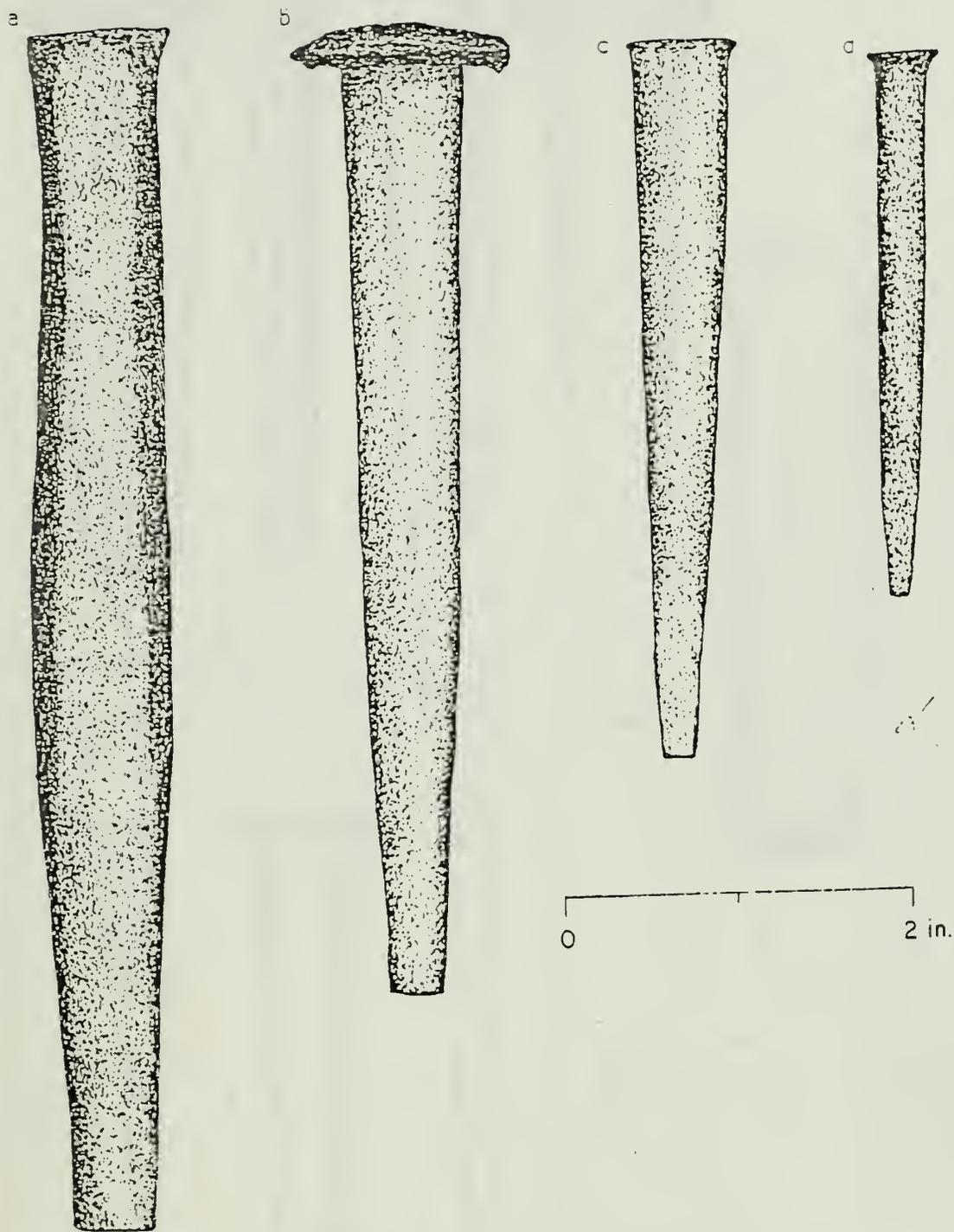


Iron anvil swages from Fort Vancouver:

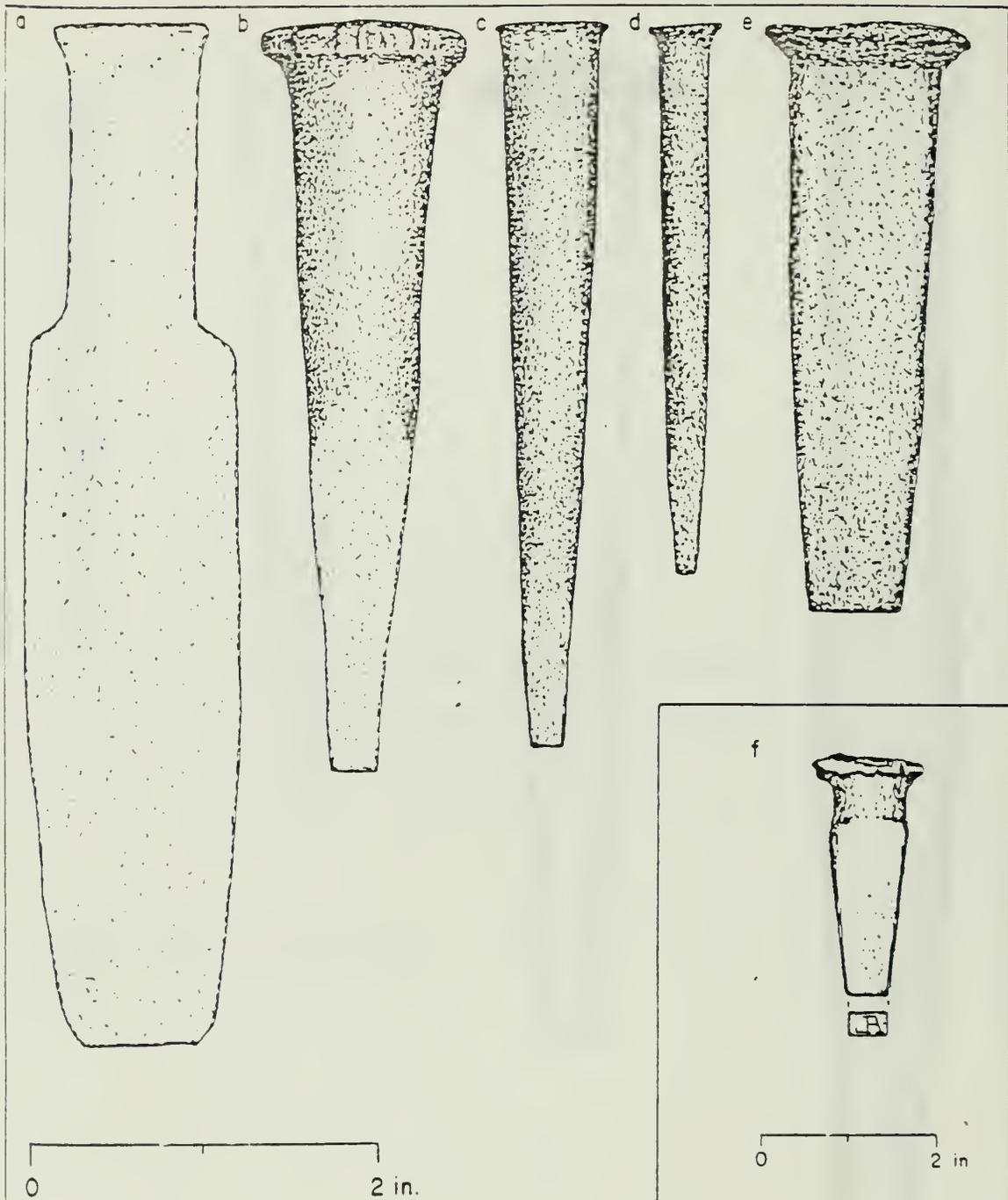
- a. Square channel (#11593).
- b. Round channel (#9054).

PLATE 26

Various Iron Punches Recovered
From Fort Vancouver Excavations



Punches from the Blacksmith Shop area: a). punch (FOVA 35367);
b). punch (FOVA 35891); c). punch (FOVA 35955) and d). punch
(FOVA 34902).

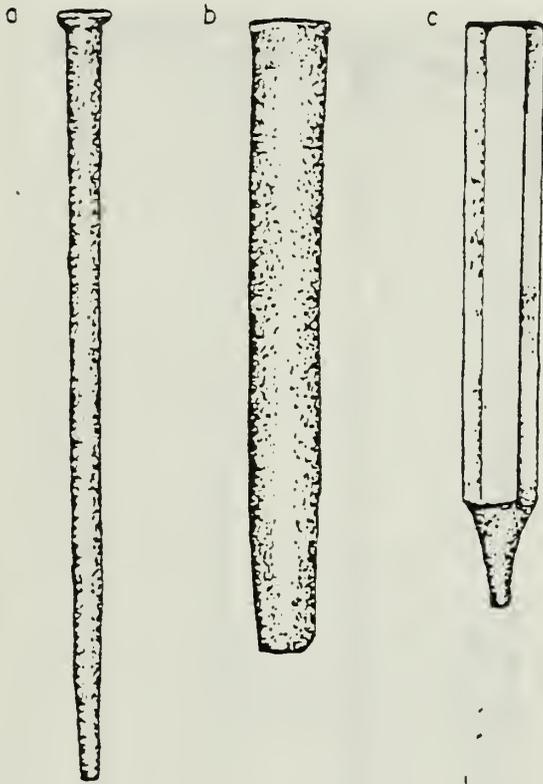


Square iron punches from Fort Vancouver:

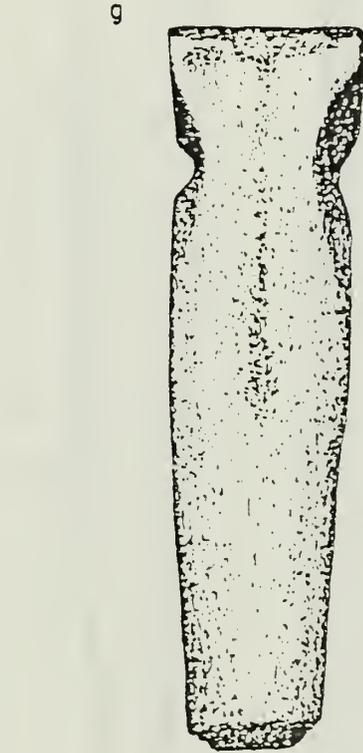
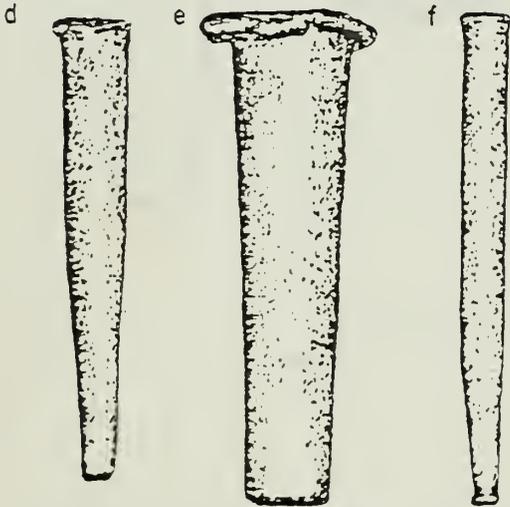
a-b. #10668.

c-e. #11598.

f. "AL" stamping punch (#11138).



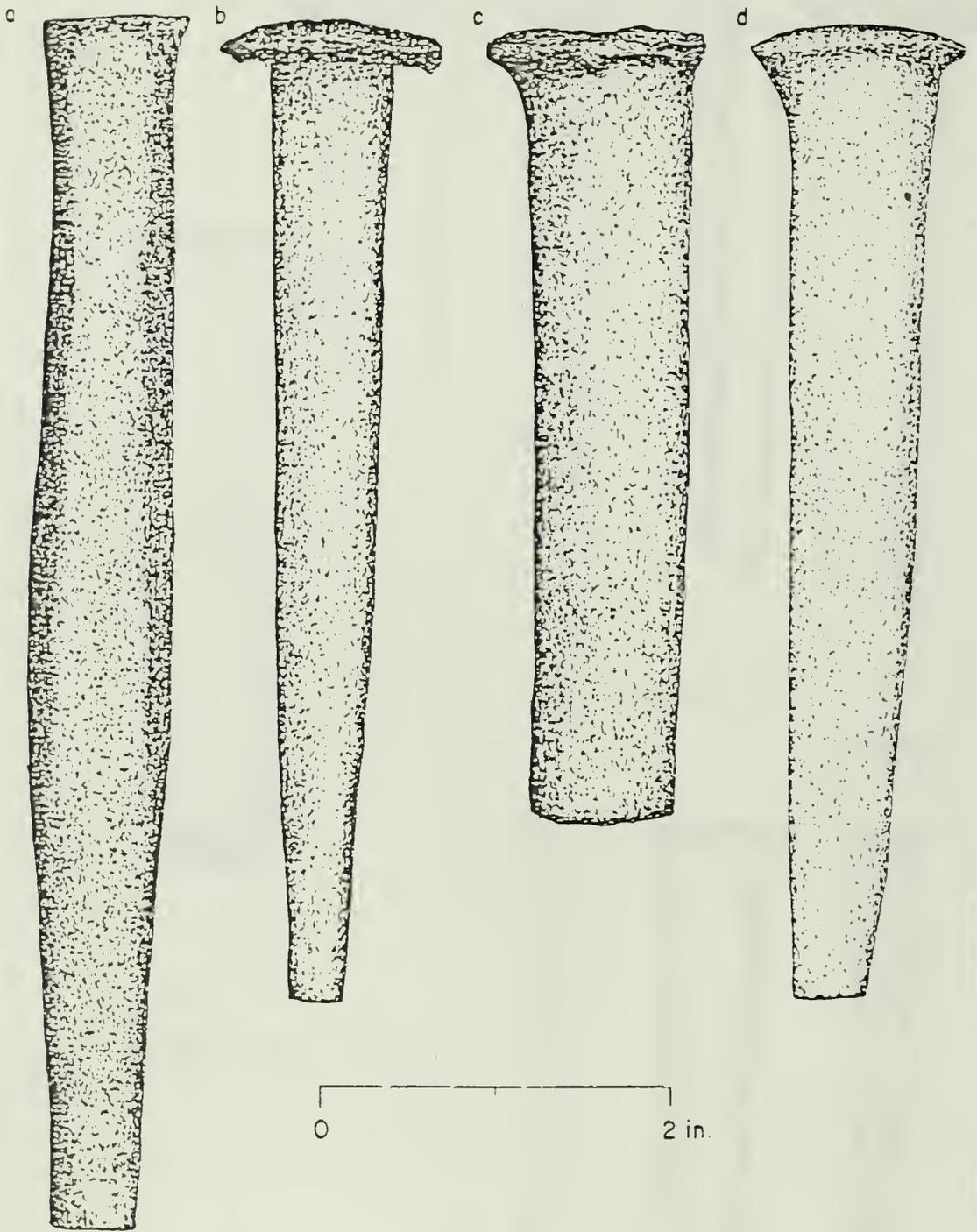
0 2 in.



0 2 in.

Round iron punches from Fort Vancouver:

a-f. #11138,
g. #11598.



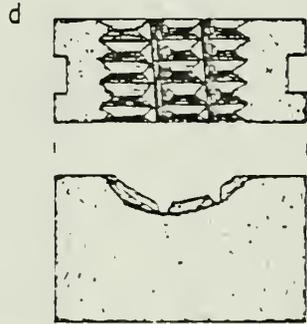
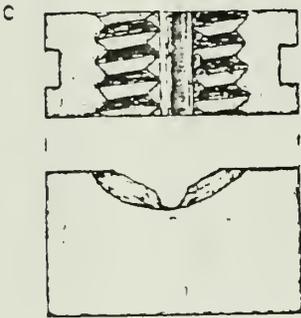
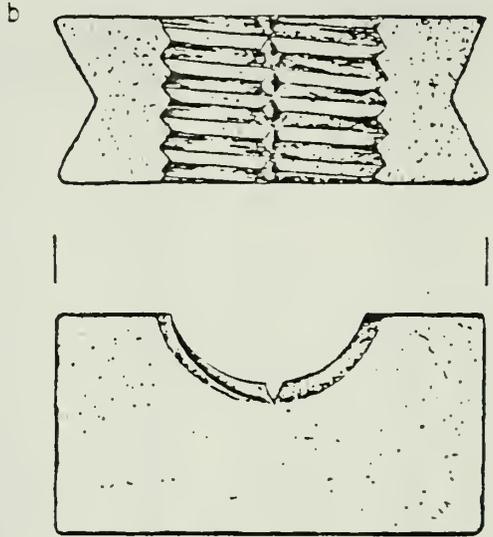
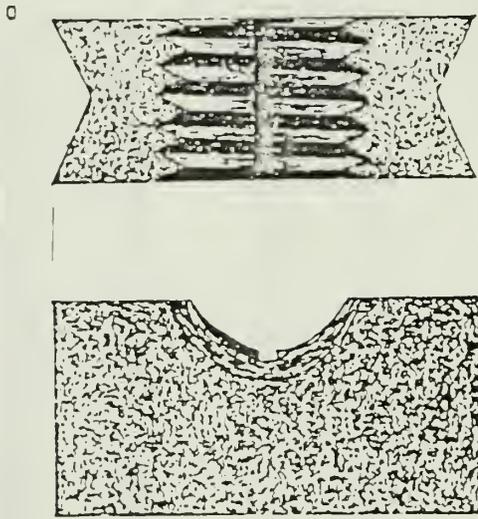
Round and oval iron punches from Fort Vancouver:

a-c. Round punches (all #11598).

c. Oval punch (#10668).

PLATE 27

Various Iron Stamping and Stock Dies
From Fort Vancouver Excavations



0 2 in.

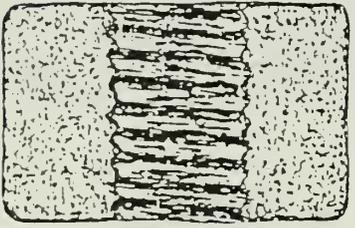
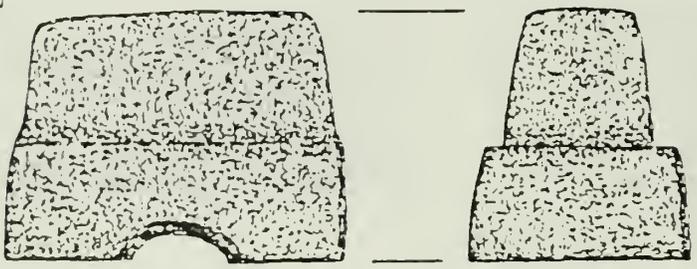
Iron stock dies from Fort Vancouver:

- a. #11594.
- b. #11132.
- c-c. #9564.

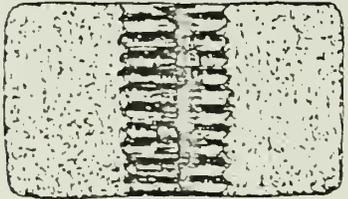
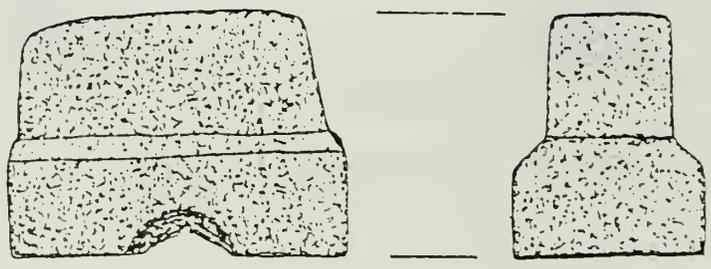
PLATE 28

- a. Iron taps from Fort Vancouver excavations
- b. a complete British tap set

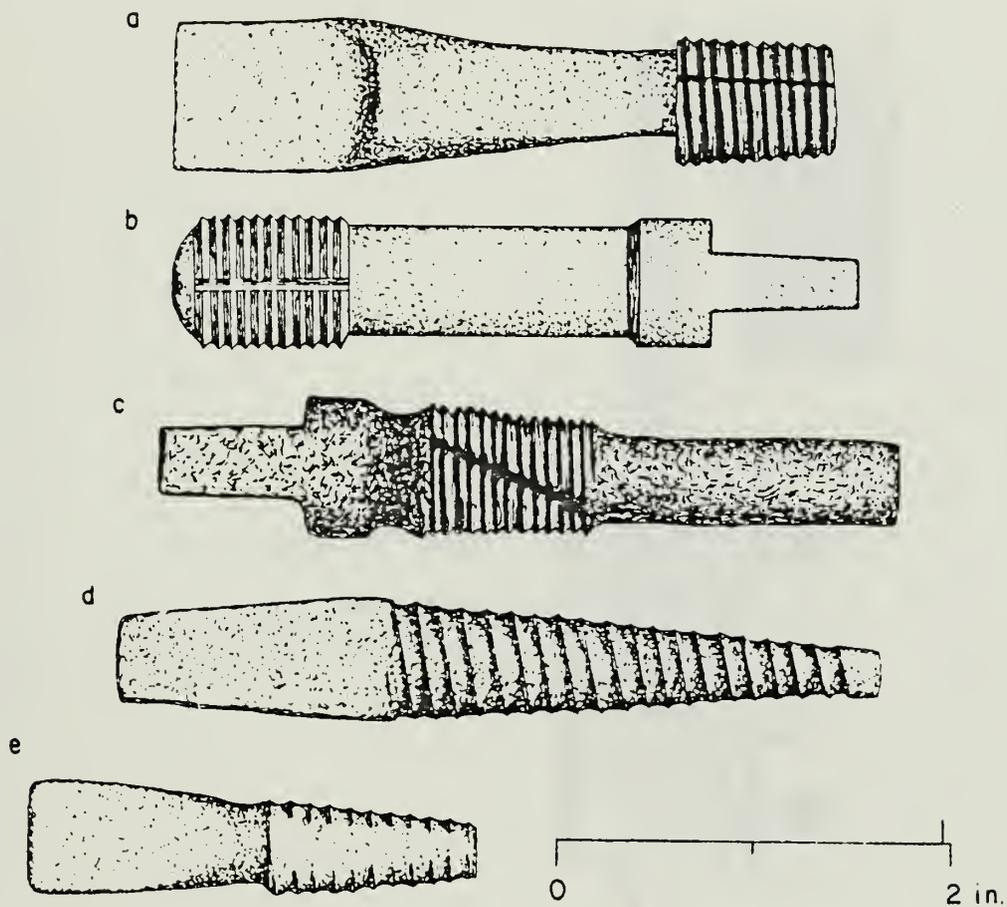
c



b

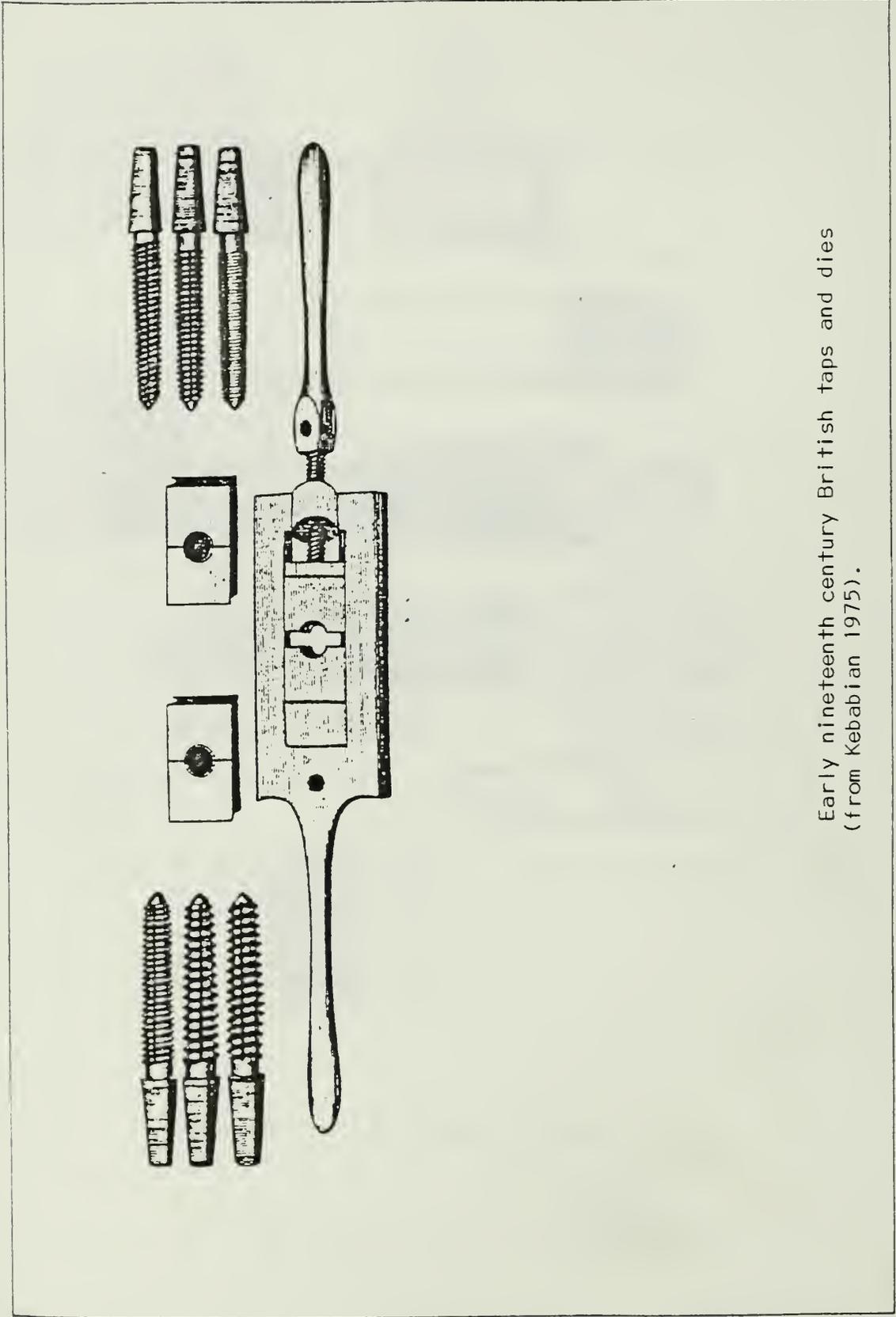


Iron stamping dies from Fort Vancouver:
(both #11594).



Iron tap styles from Fort Vancouver:

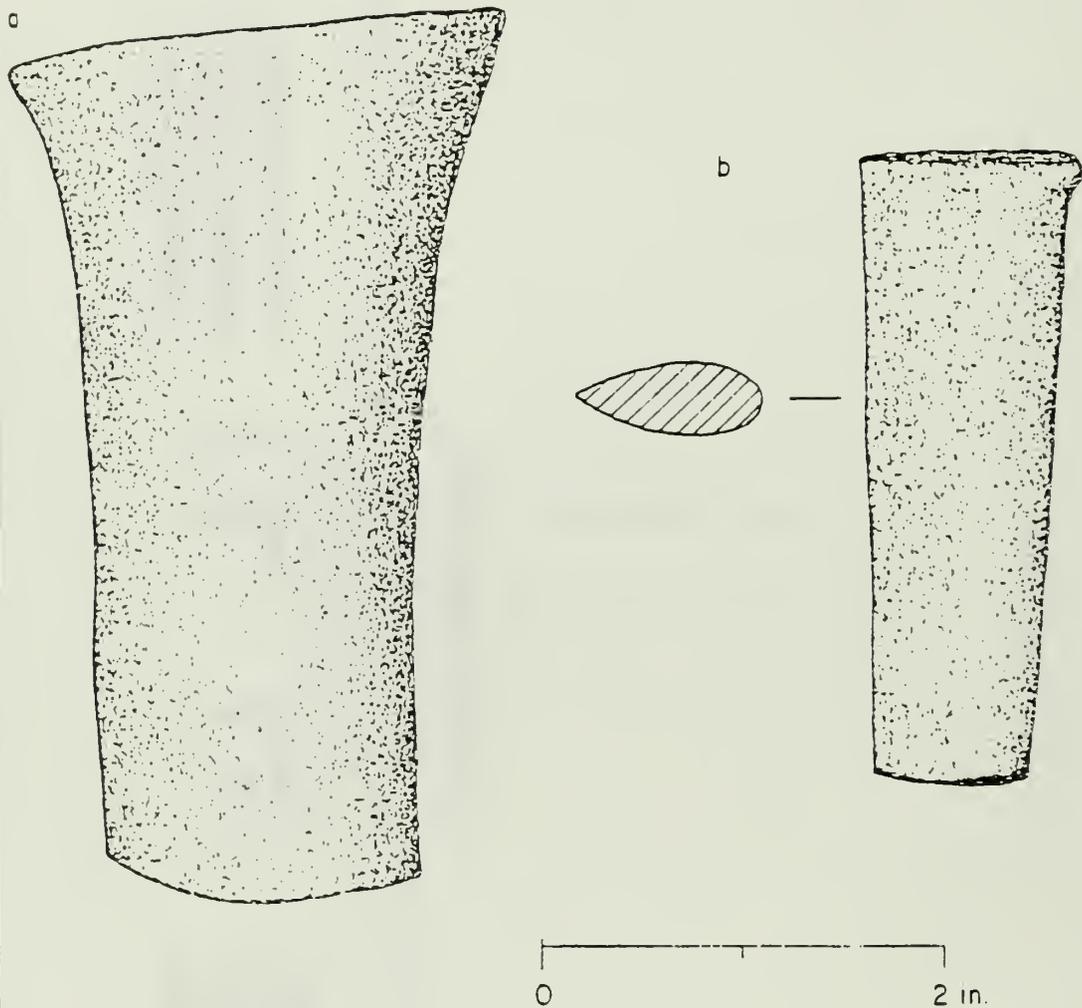
- a. #10664.
- b. #9303.
- c. #8458.
- d-e. #11596.



Early nineteenth century British taps and dies
(from Kebabian 1975).

PLATE 29

Iron Axe Mandrils From
Fort Vancouver Excavations



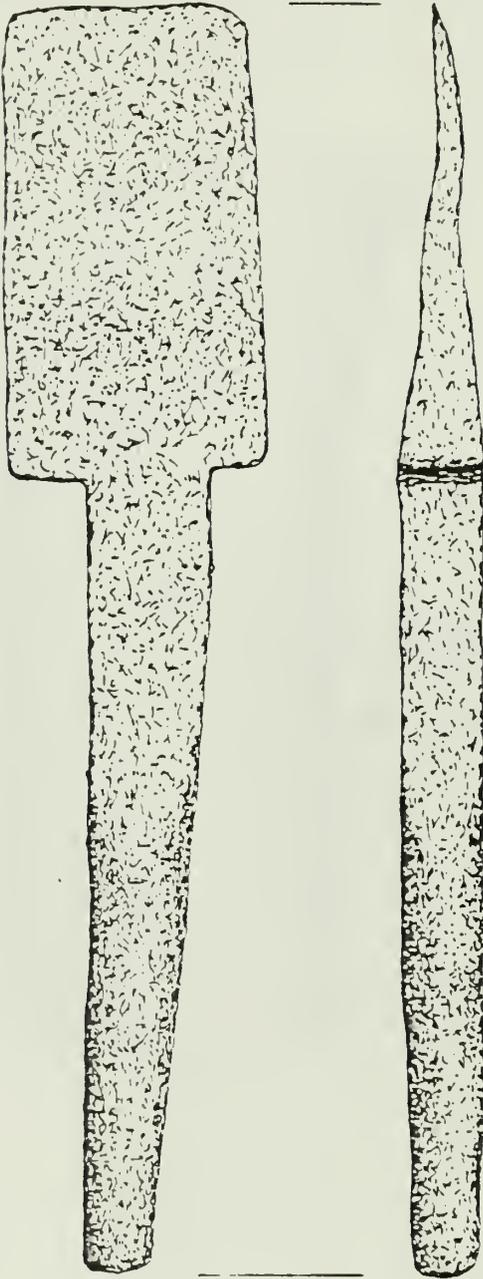
Iron axe mandrills from Fort Vancouver:

- a. Large mandrill (#10667).
- b. Small mandrill (#11590).

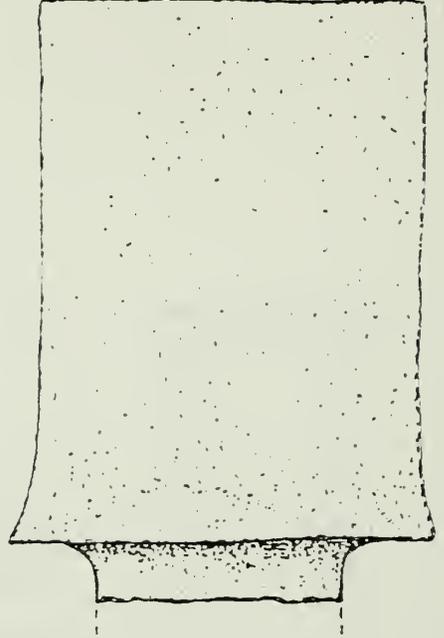
PLATE 30

Iron Anvil Hot Sets From
Fort Vancouver Excavations

a



b



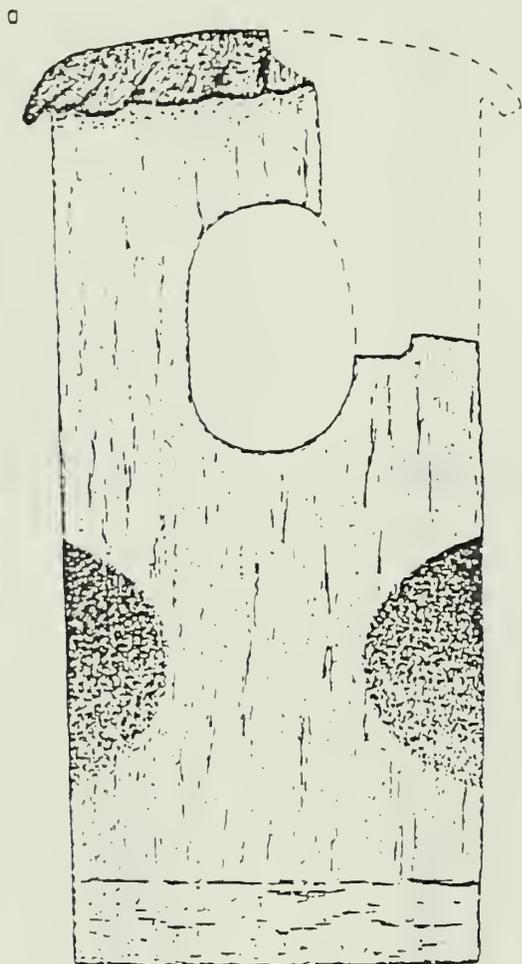
0 2 in

Iron anvil hot sets from Fort Vancouver:

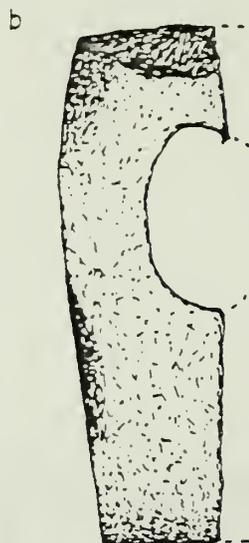
- a. #9595.
- b. #10663.

PLATE 31

Iron Flatter Recovered From
Fort Vancouver Excavations



0 2 in.



0 2 in.

Iron flatter and fuller from Fort Vancouver:

- a. Flatter (#10662).
- b. Fuller fragment (#9590).

PLATE 32

Iron Files From
Fort Vancouver Excavations

a



b

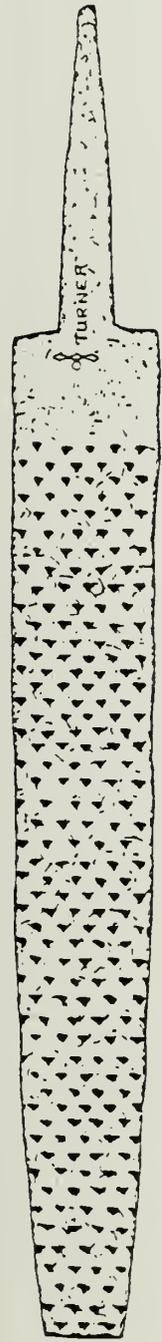


c



Iron files from Fort Vancouver:

- a. "LOXLEY" blacksmiths rubber file (#11579).
- b. "TURNER" half round bastard file (#11146).
- c. Flat smooth file (#11583).



a



b

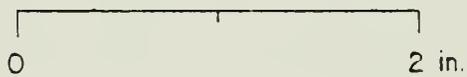
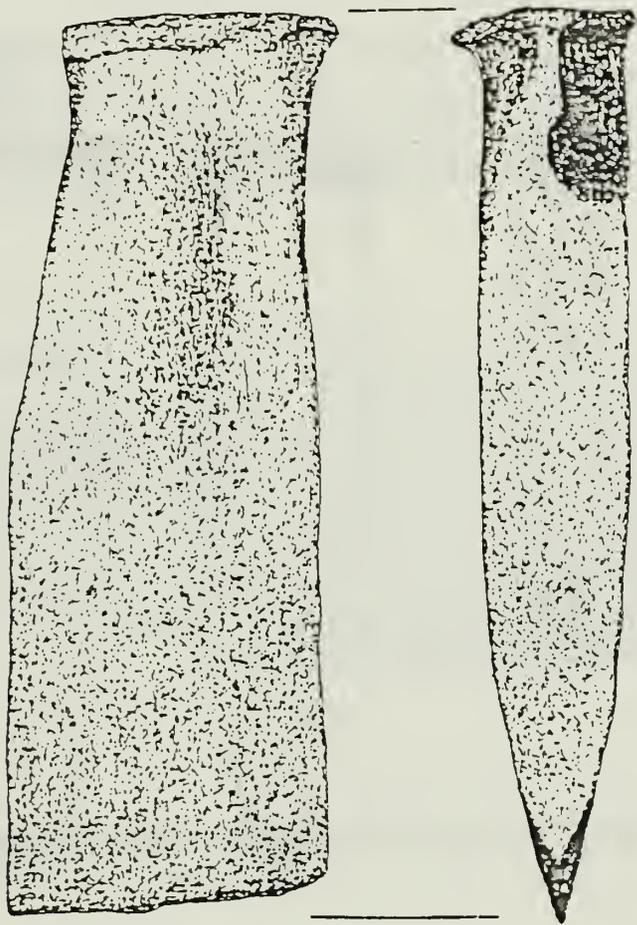


Iron files from Fort Vancouver:

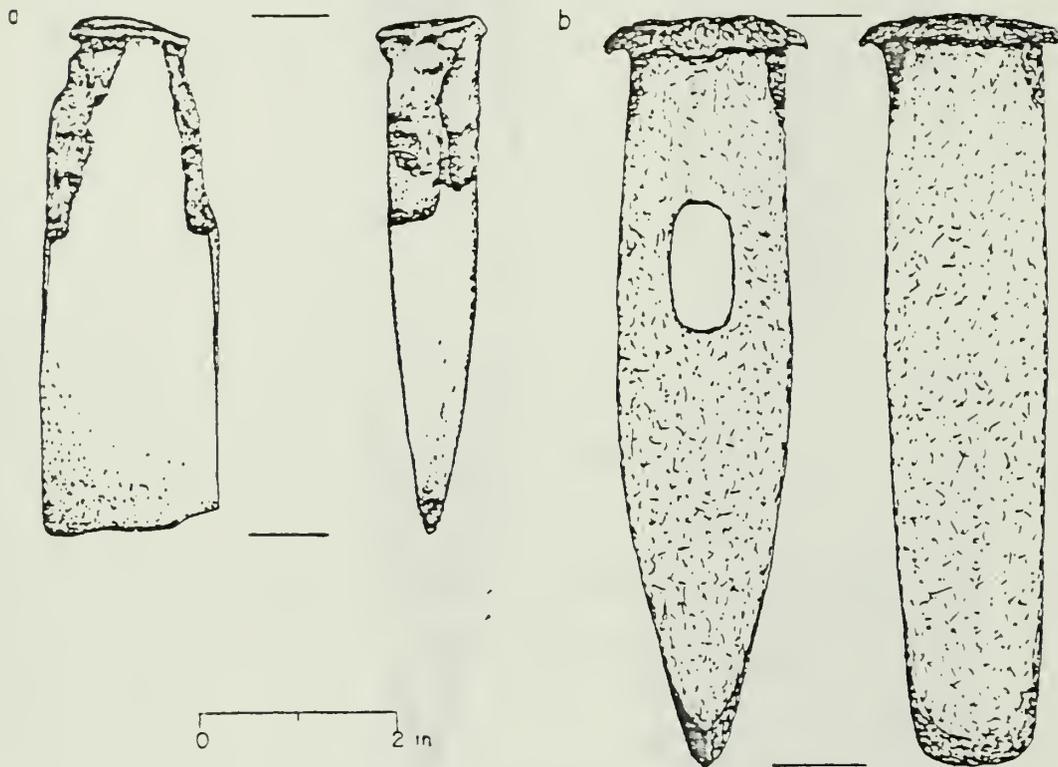
- a. "TURNER" flat rasp (#8278).
- b. Rattle file (#10655).
- c. Three square smooth file (#8277).

PLATE 33

Iron Hot Chisel Sets From
Fort Vancouver Excavations

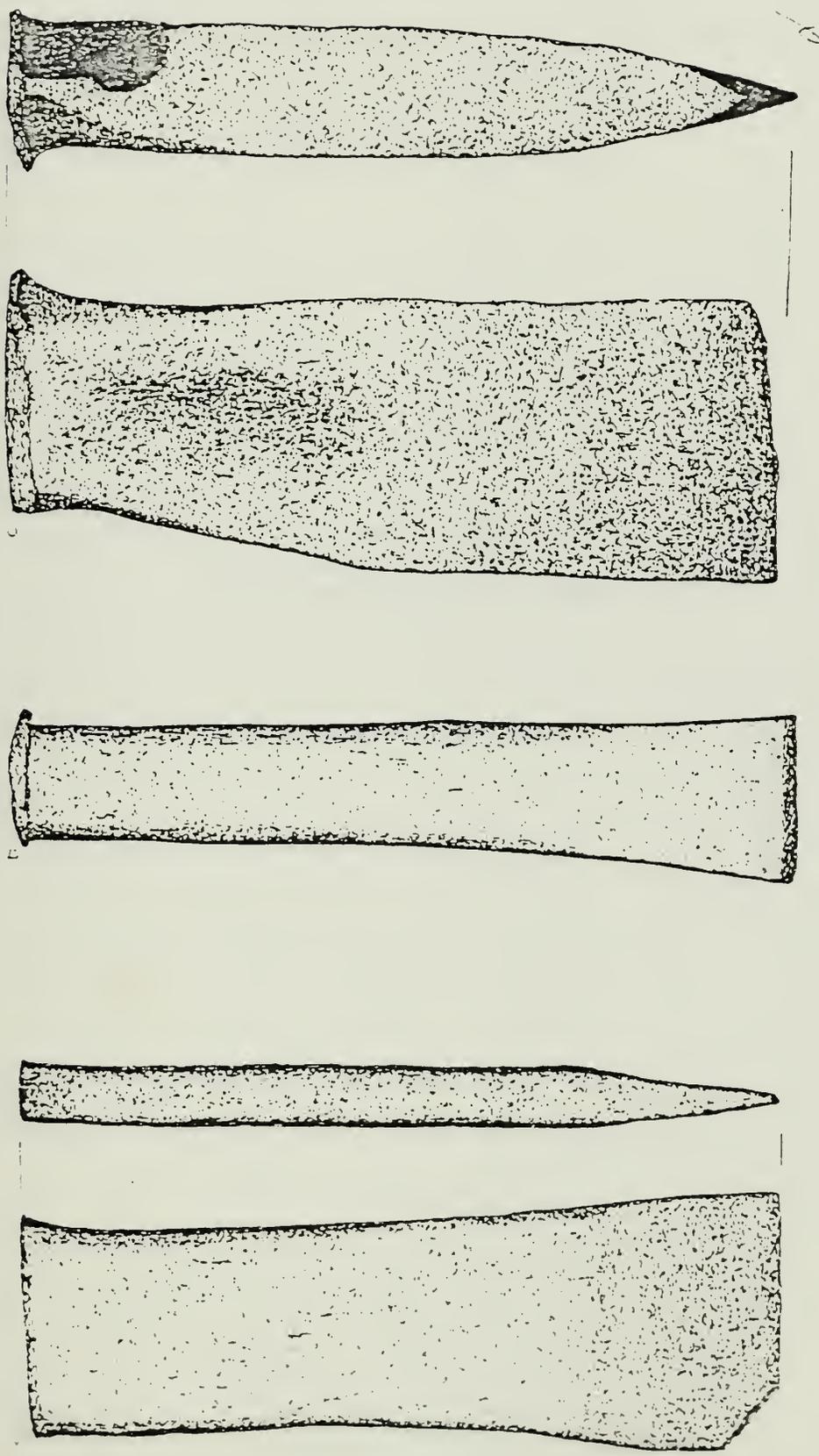


Iron hot chisel from Fort Vancouver (#11595).



Iron chisels from Fort Vancouver:

- a. Hot chisel (#11133),
- b. Cold chisel (#7470).

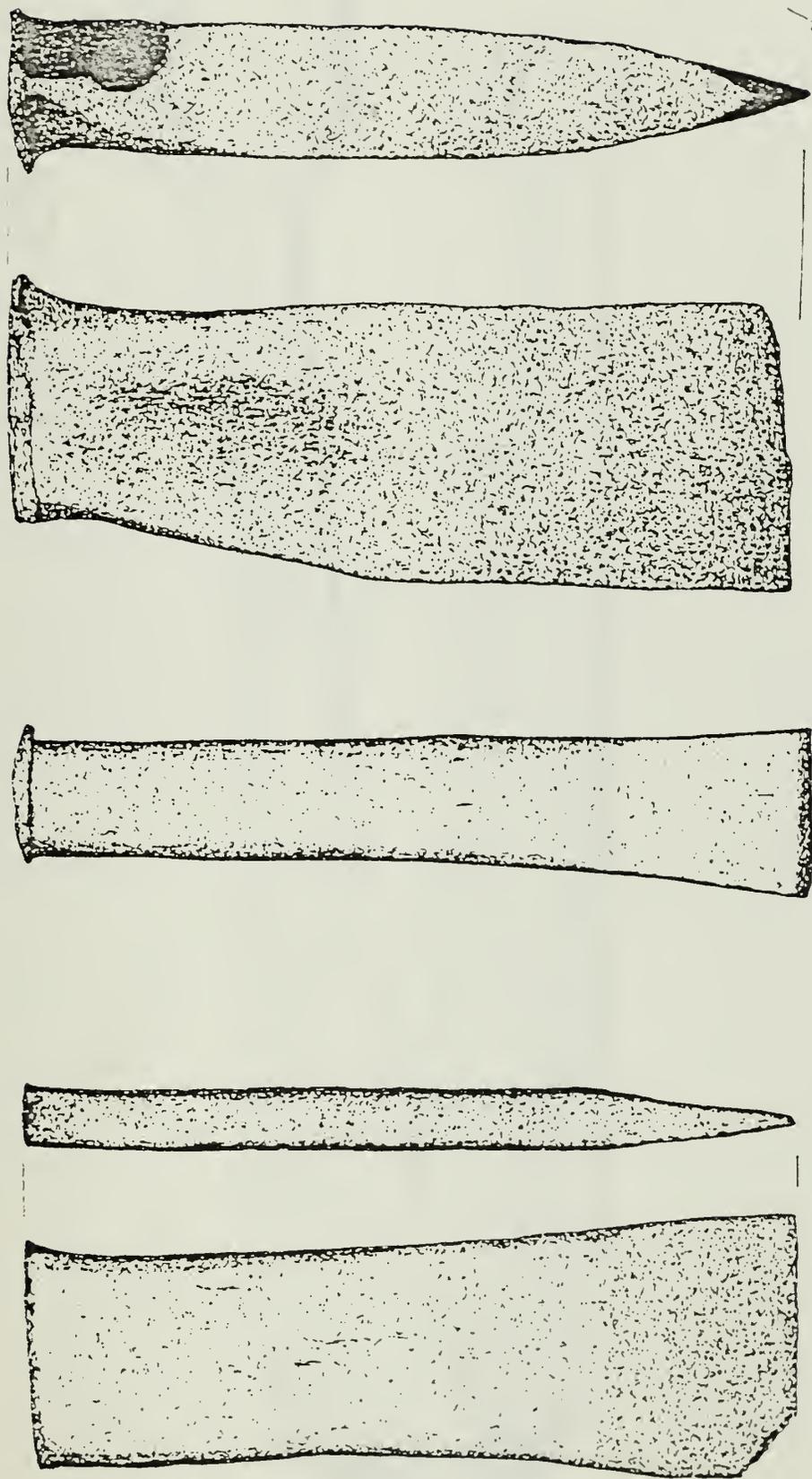


0 2 in.

Chisels from the Blacksmith Shop area: a). chisel (FOVA 34755); b). chisel (FOVA 34901) and c). chisel (FOVA 33152).

PLATE 34

Iron Chisels From
Fort Vancouver Excavations



Chisels from the Blacksmith Shop area: a). chisel (FOVA 34755); b). chisel (FOVA 34901) and c). chisel (FOVA 33152).

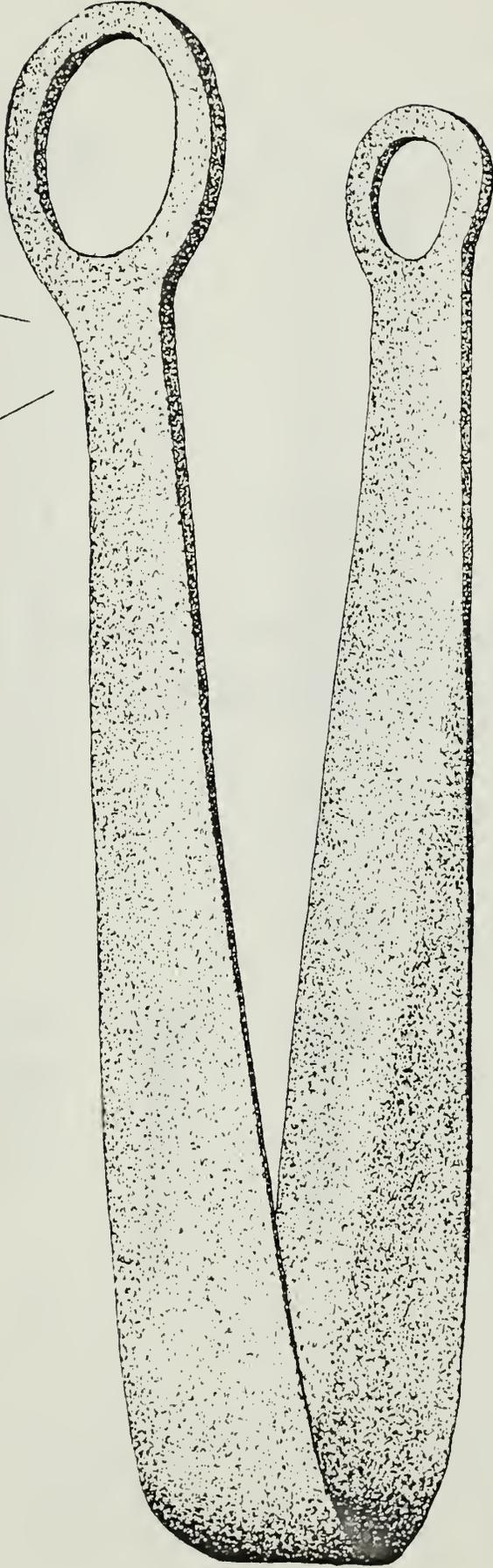
PLATE 35

Reconstructed Iron Trap Spring
From Fort Vancouver Excavations

JB

GF

0 2 in.

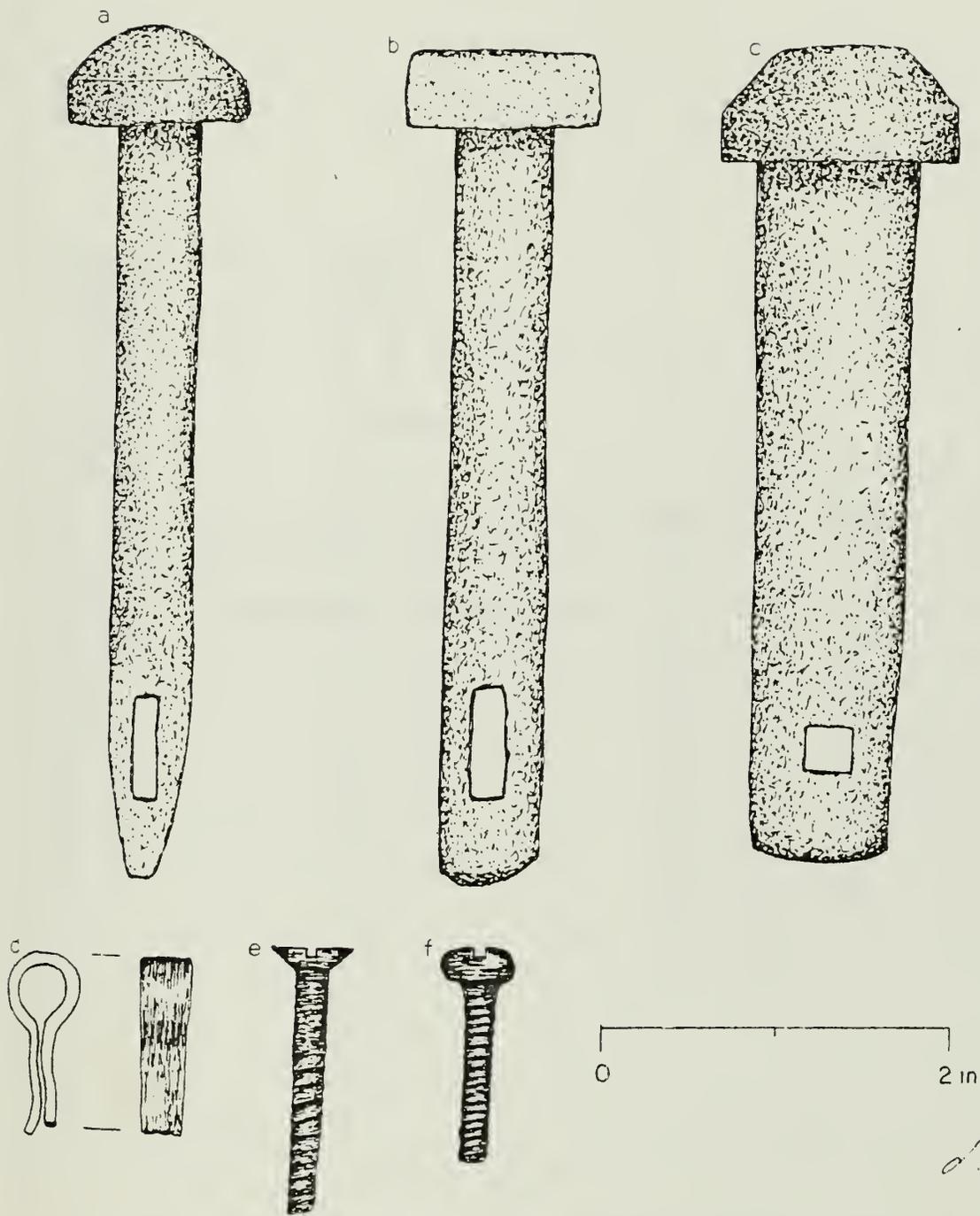


Reconstructed trap spring with makers' marks found on springs from the Blacksmith Shop.

PLATE 36

Various Iron Bolts and Screws From
Fort Vancouver Excavations

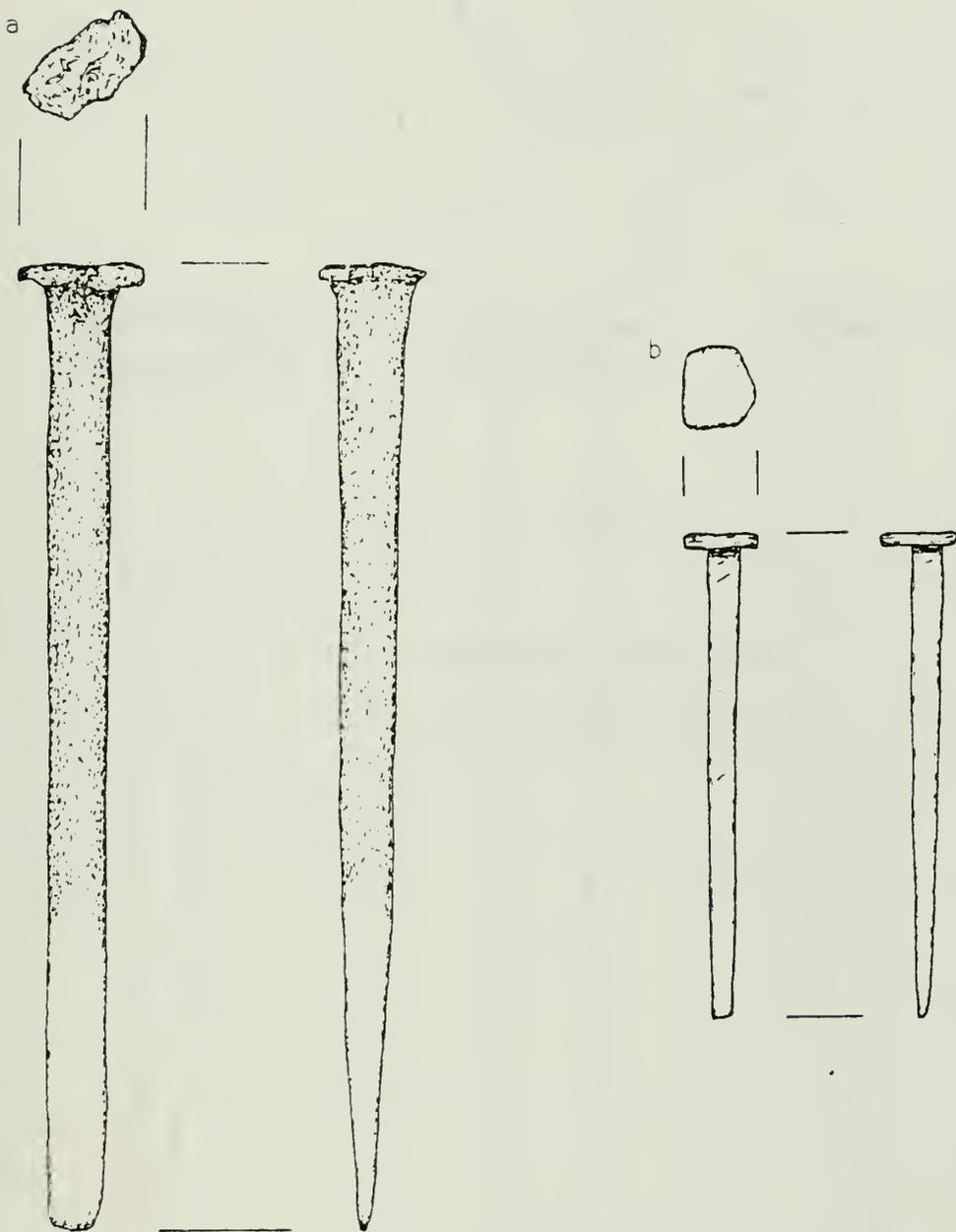
Note: Screws without points



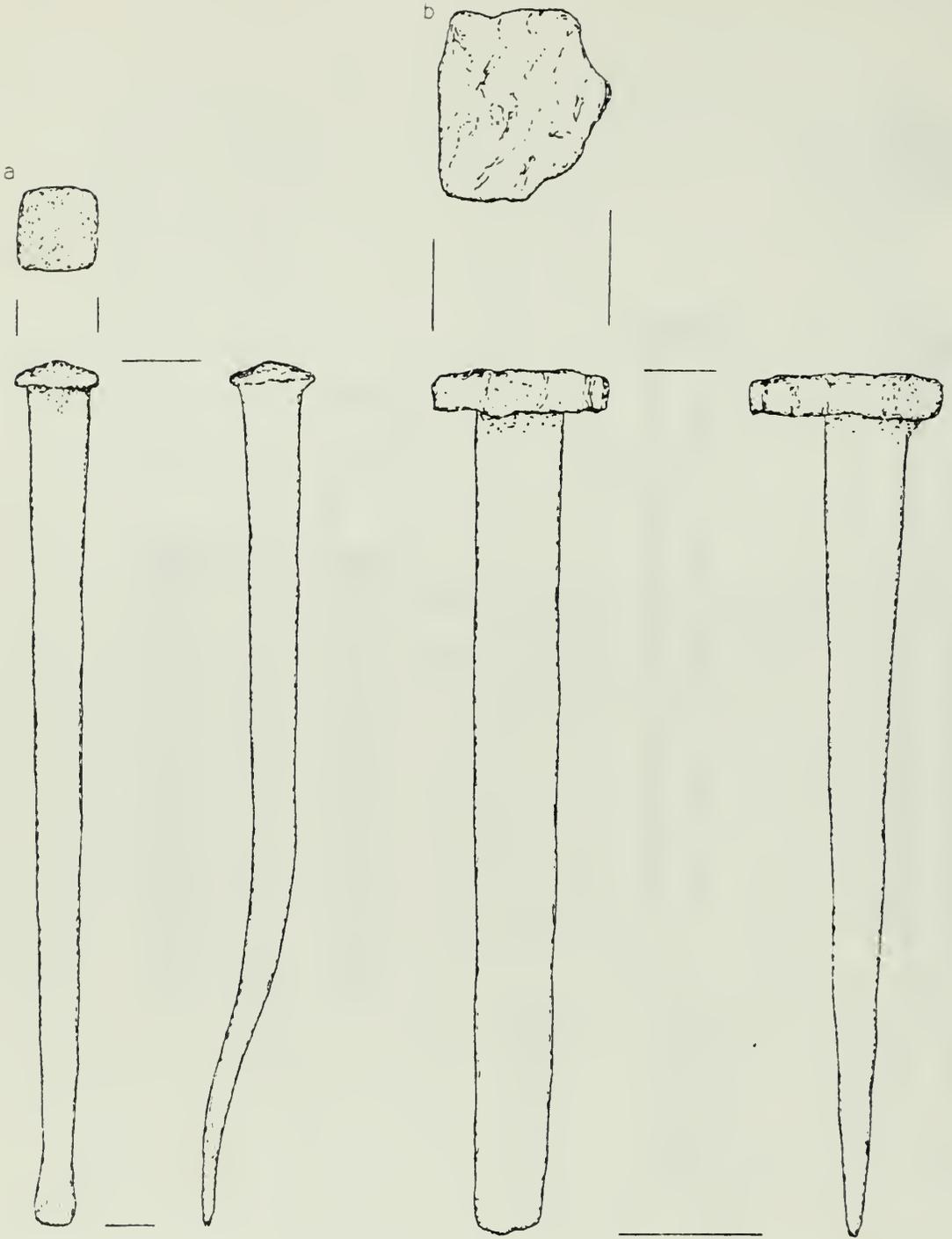
Cotter bolts, a cotter pin and screws from the Blacksmith Shop area: a). cotter bolt (FOVA 36068); b). cotter bolt (FOVA 35629); c). cotter bolt (FOVA 33783), d). cotter pin (FOVA 35993); e). screw (FOVA 35462) and f). screw (FOVA 34961).

PLATE 37

Various Wrought Nail Types From
Fort Vancouver Excavations



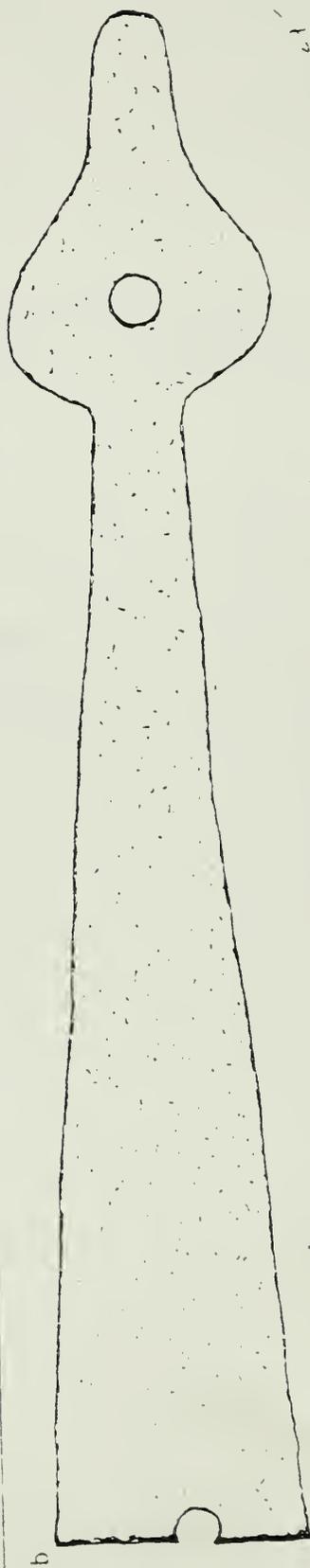
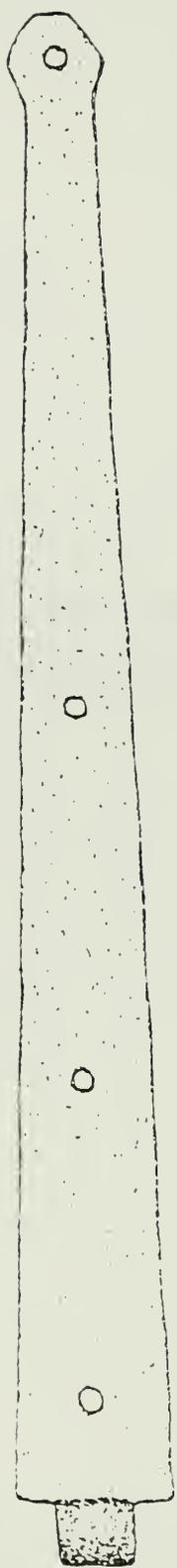
New wrought rod nail varieties from the Blacksmith Shop area: a). nail Variety #1119 (FOVA 33328 -- L=8.93 cm.) and b). copper nail Variety #1120 (FOVA 33558 -- L=4.105 cm).



New wrought rod nail varieties from the Blacksmith Shop area: a). nail Variety #1117 (FOVA 32295 -- L=18.9cm) and b). nail Variety #1118 (FOVA 33235 -- L=6.2cm.).

PLATE 38

Iron Strap Hinges From
Fort Vancouver Excavations

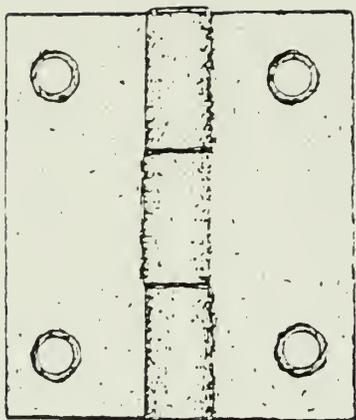


Strap hinges from the Blacksmith Shop area: a). strap hinge (FOVA 3444) and b). strap hinge (FOVA 34549).

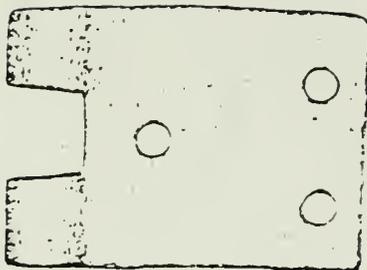
PLATE 39

Iron Butt Hinges From
Fort Vancouver Excavations

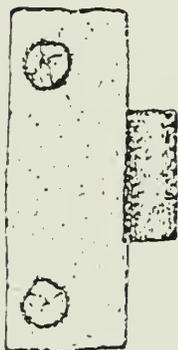
a



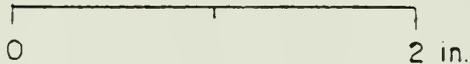
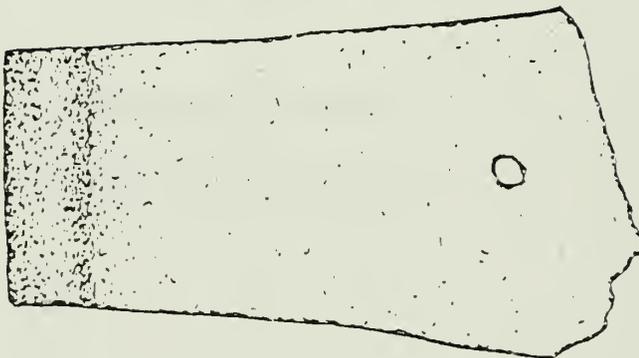
b



c



d

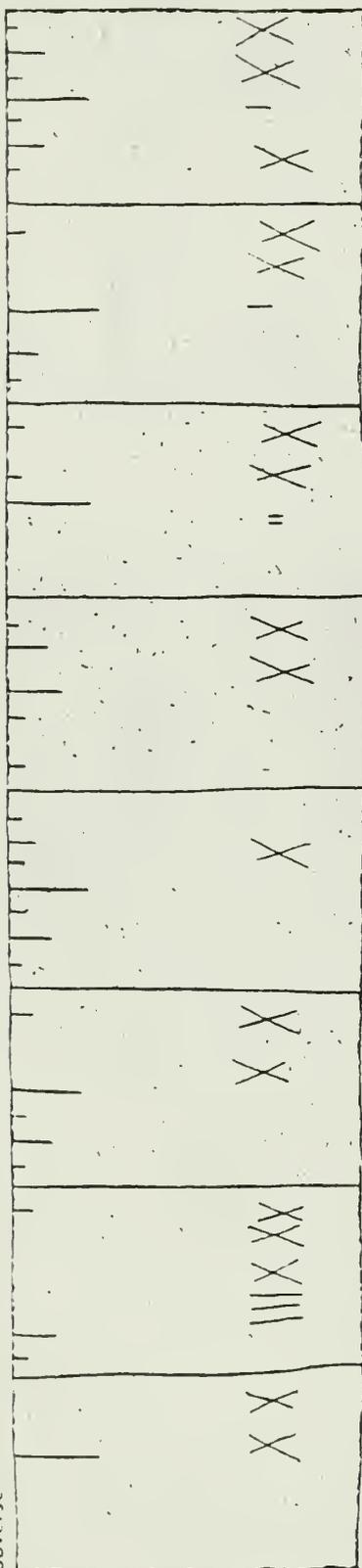


Hinges from the Blacksmith Shop area: a). butt hinge (FOVA 34894); b). hinge (FOVA 35359); c). butt hinge w/#1002 nails (FOVA 34290) and d). butterfly hinge (FOVA 35776).

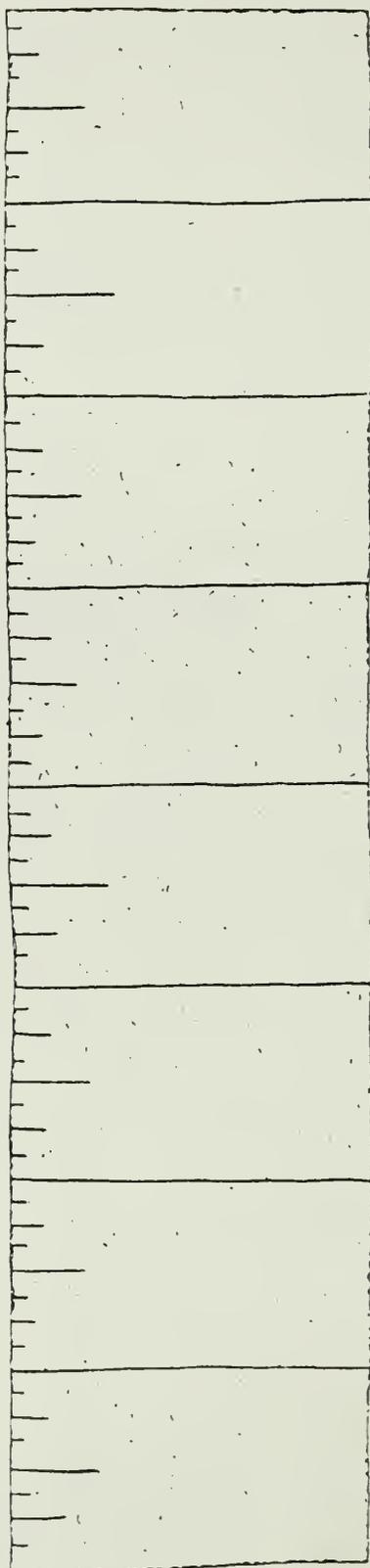
PLATE 40

Hudson Bay Company Iron Rule From
Fort Vancouver Excavations

obverse



reverse



0 1 2 3 4 5 6 7 8 in

Iron ruler from Fort Vancouver (#10669).

PLATE 41

Early 19th Century

Bow Drill



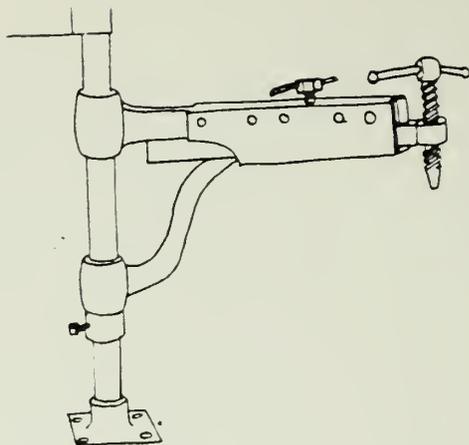
A Bow Drill in use, with breast-plate

PLATE 42

Early 19th Century

Bench Press Drills

Bench Press Drills (Smith's Drill)



Typical home-made Bench Drills

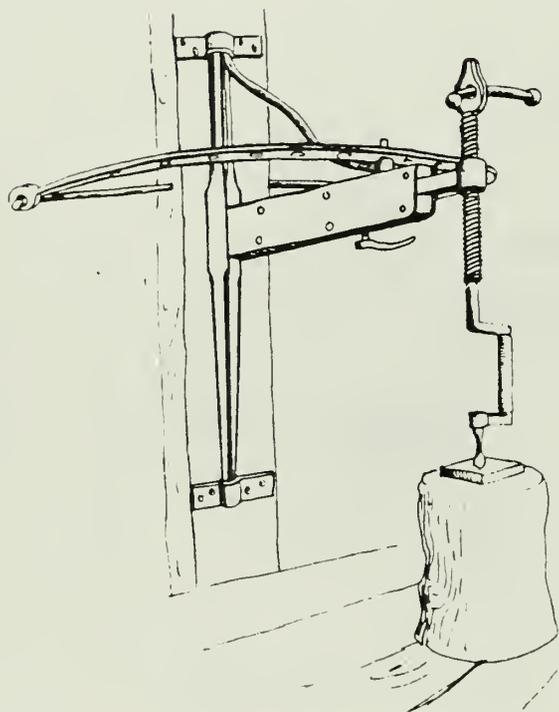


PLATE 43

Tinsmith Working In
Tinsmith Shop at Old Fort William
Ontario

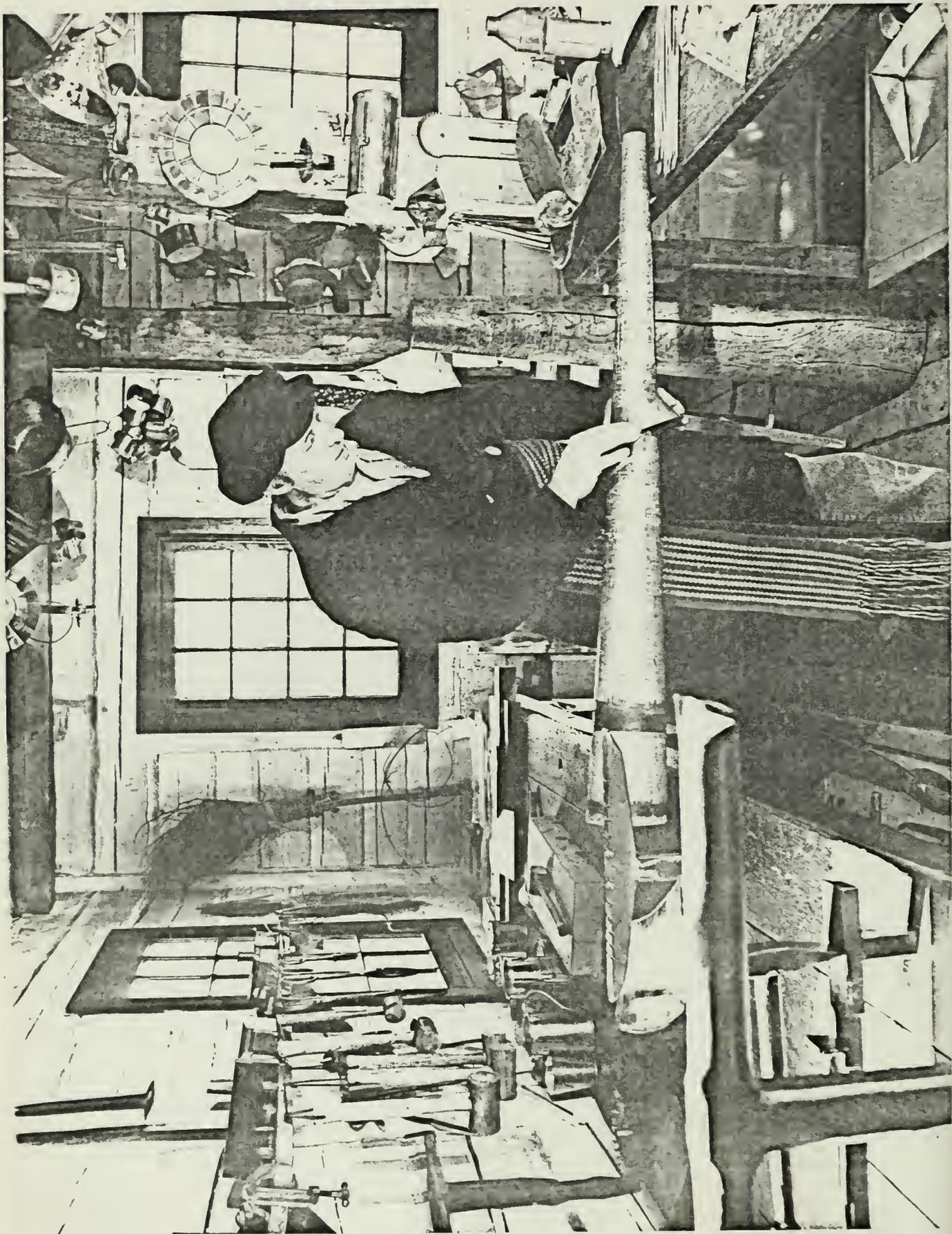


PLATE 44

Interior of Tinsmith Shop

Old Fort William

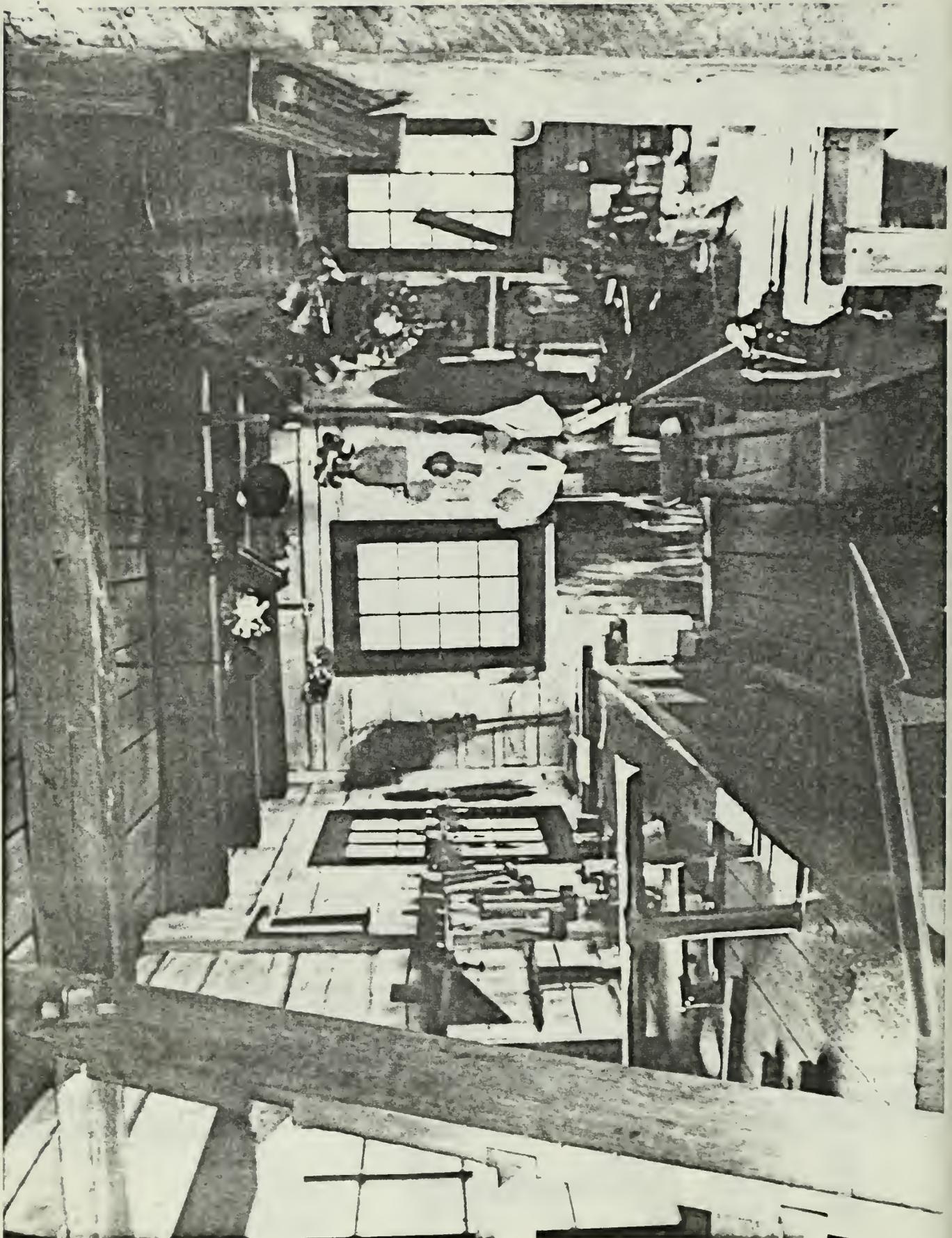


PLATE 45

Tinsmith's Tools in
Tinsmith Shop at Old Fort William

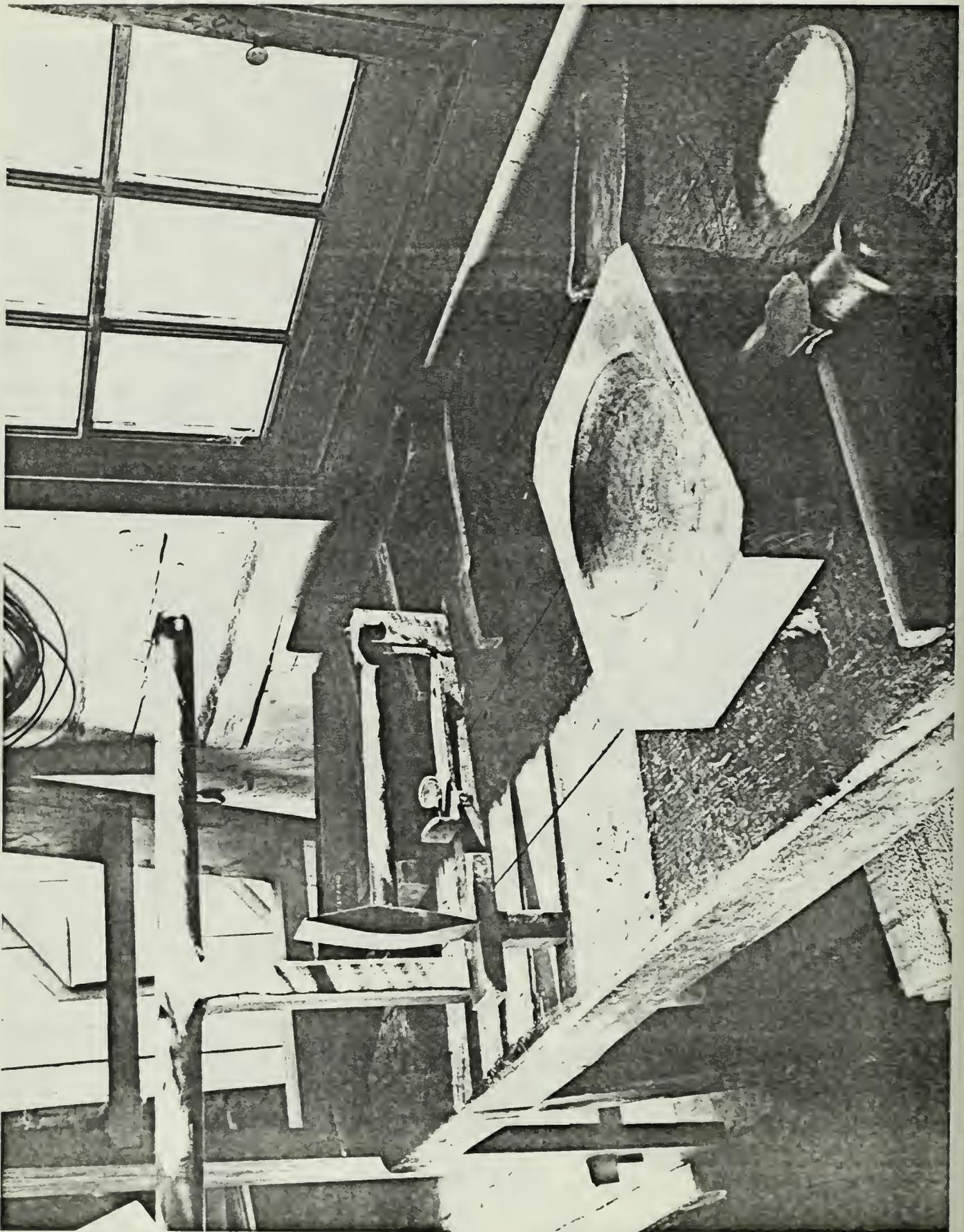


PLATE 46

Charcoal Brazier and Soldering Irons
in Tinsmith Shop
at Old Fort William



PLATE 47

Tinsmith's Hammer and Stake

Old Fort William

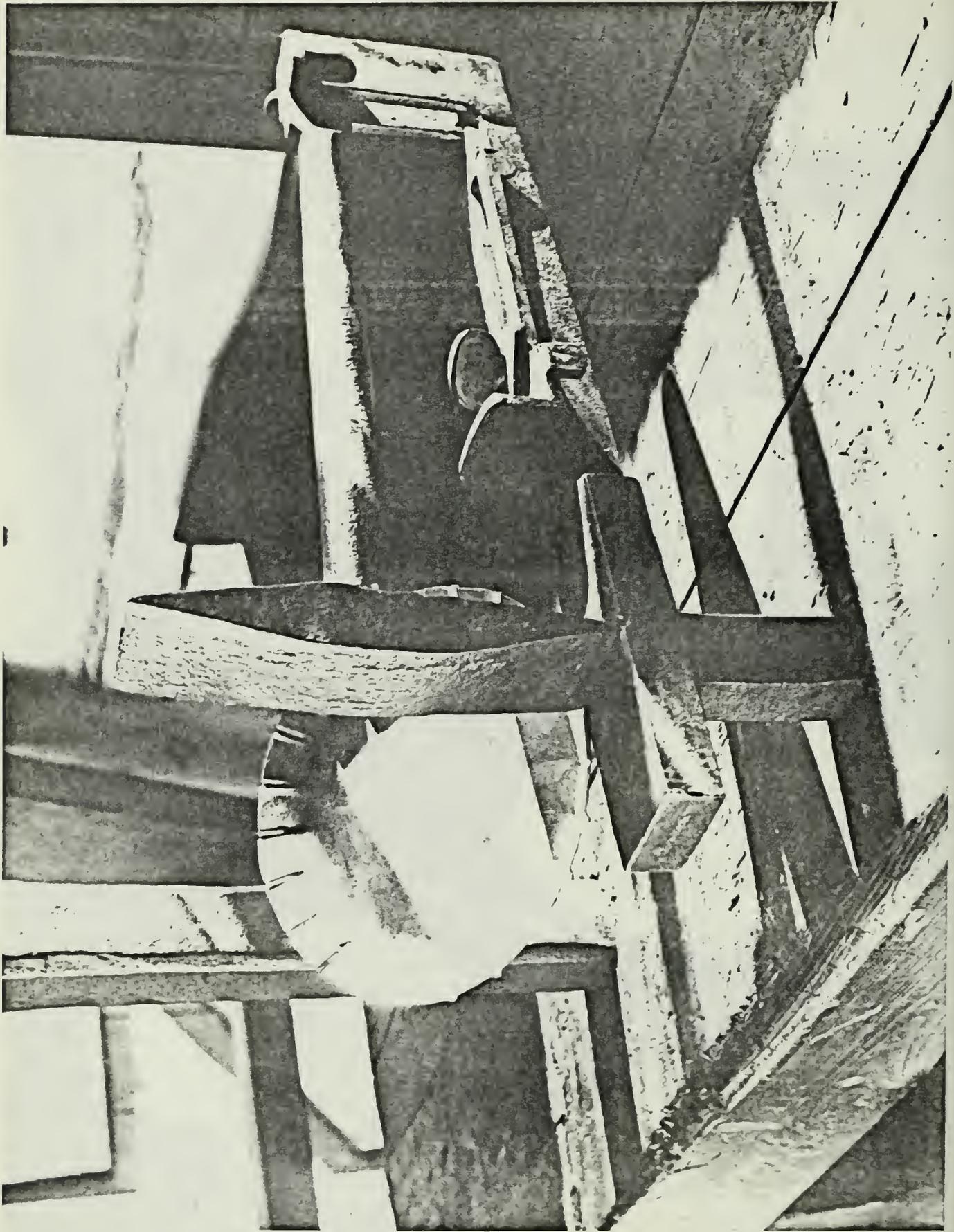


PLATE 48

Interior of Tinsmith Shop At
Old Fort William

showing benches and finished and half-
finished items

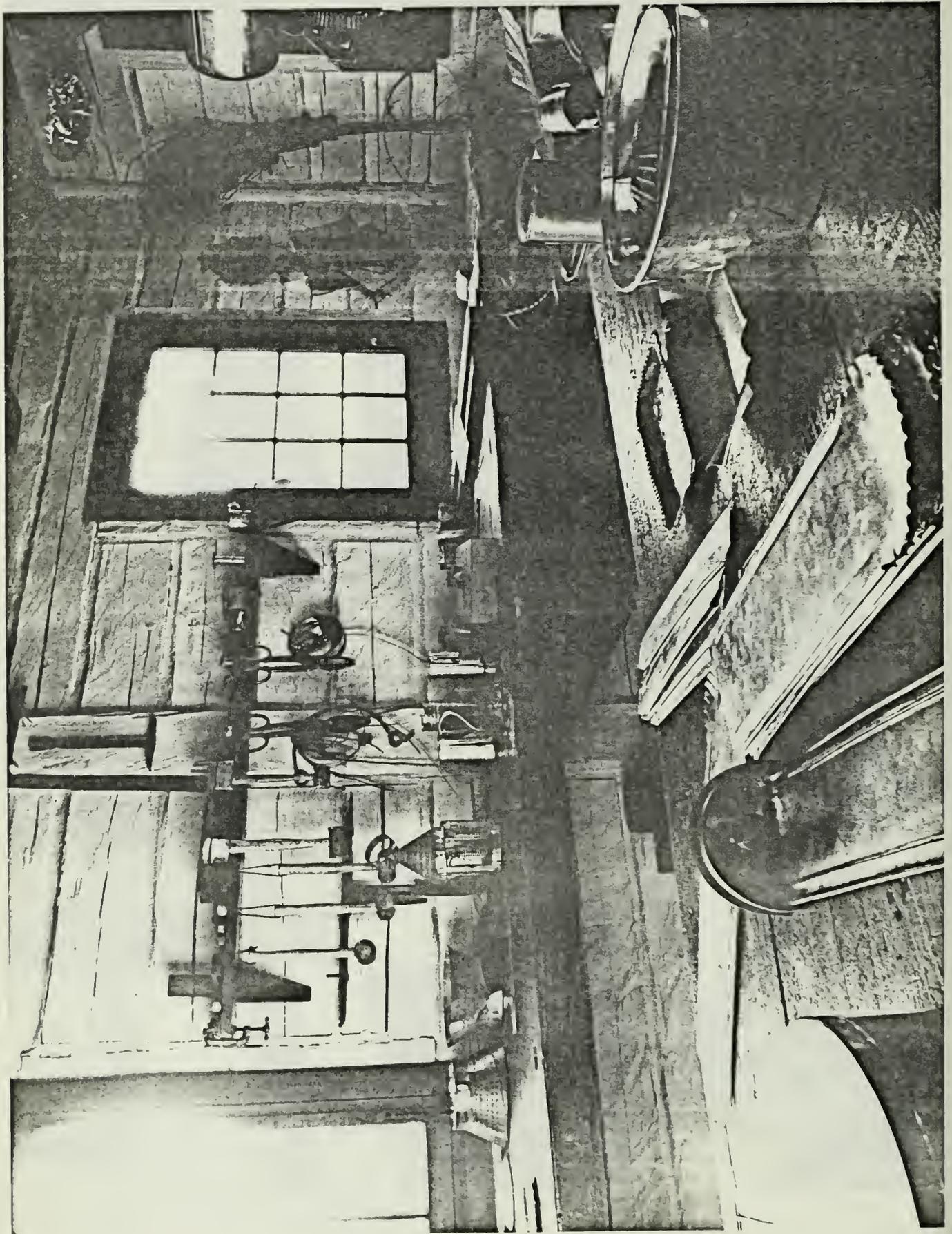


PLATE 49

Interior of Tinsmith Shop at
Old Fort William

showing a mass of finished tin items

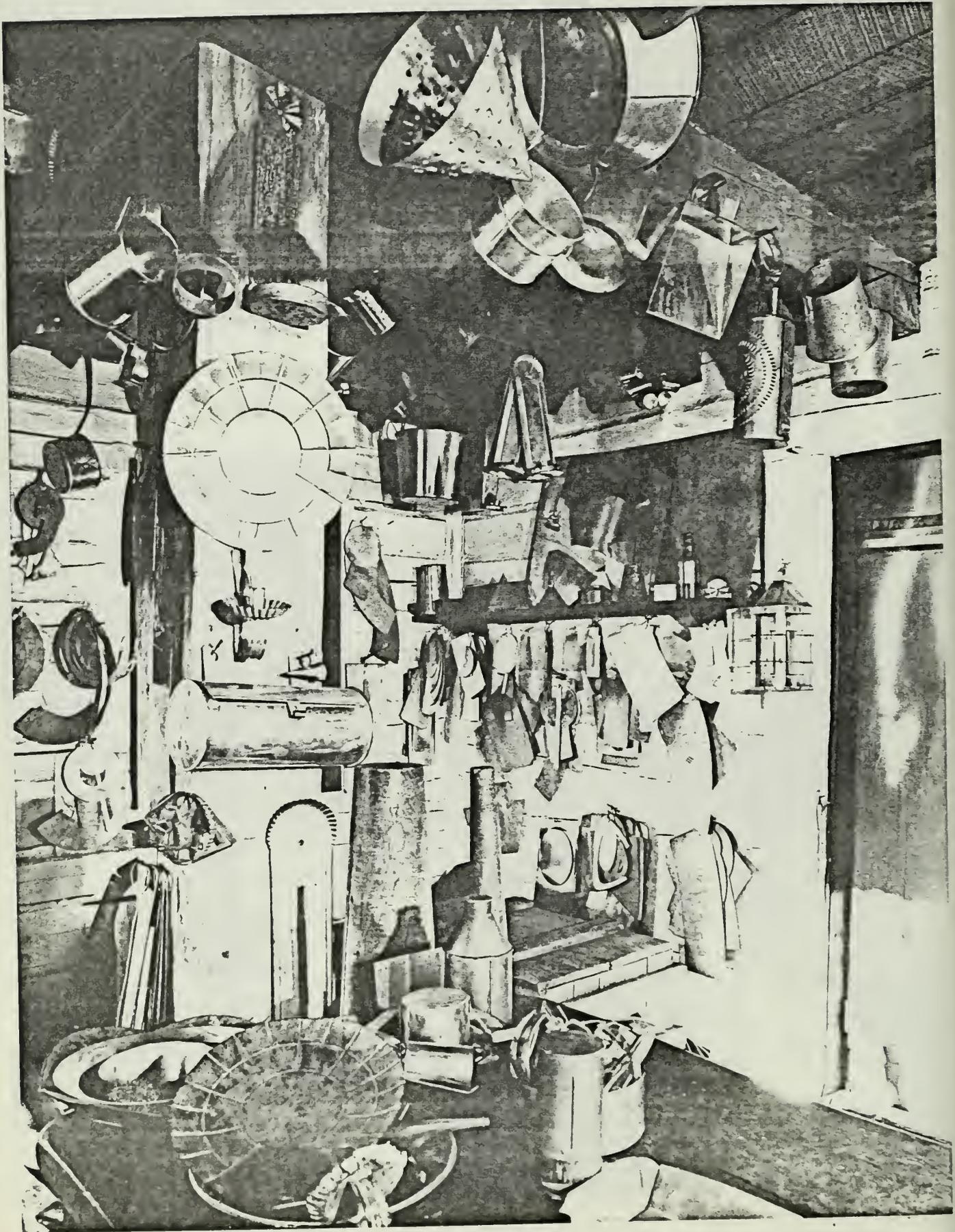
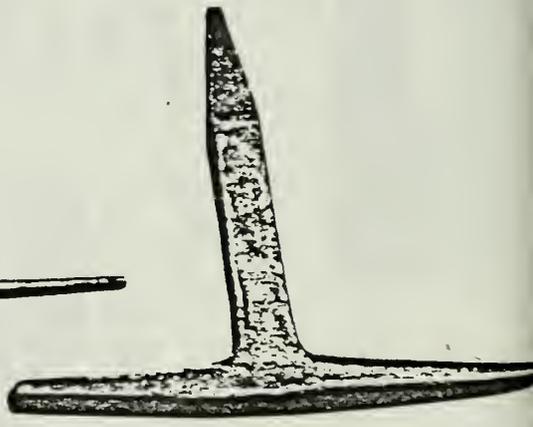
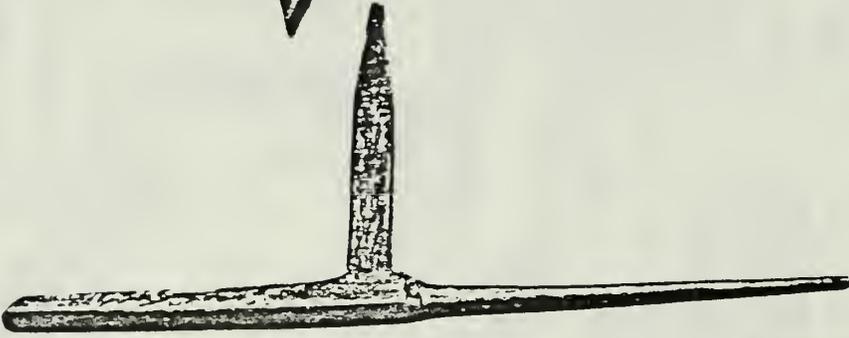
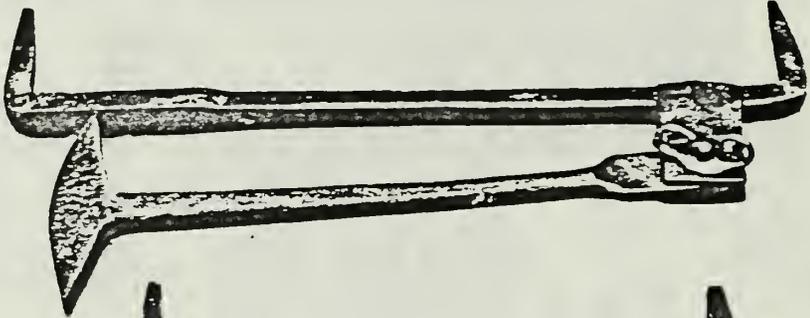
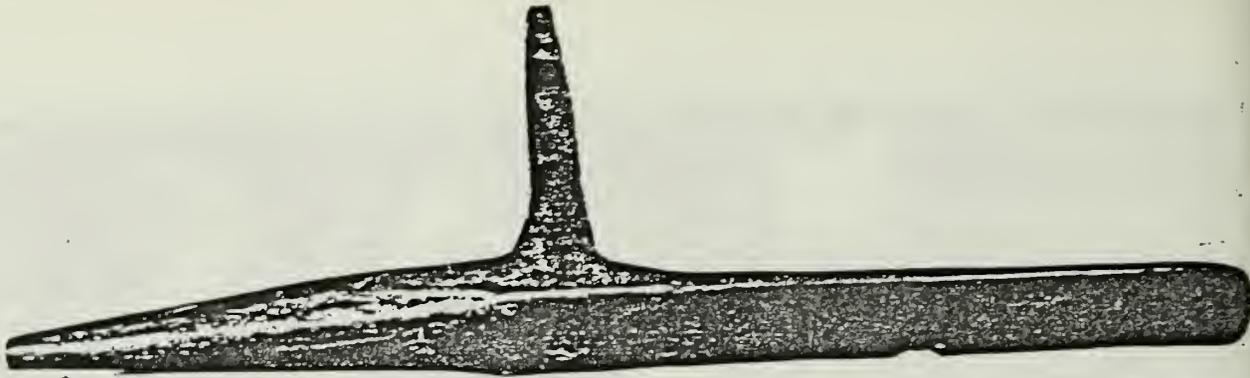
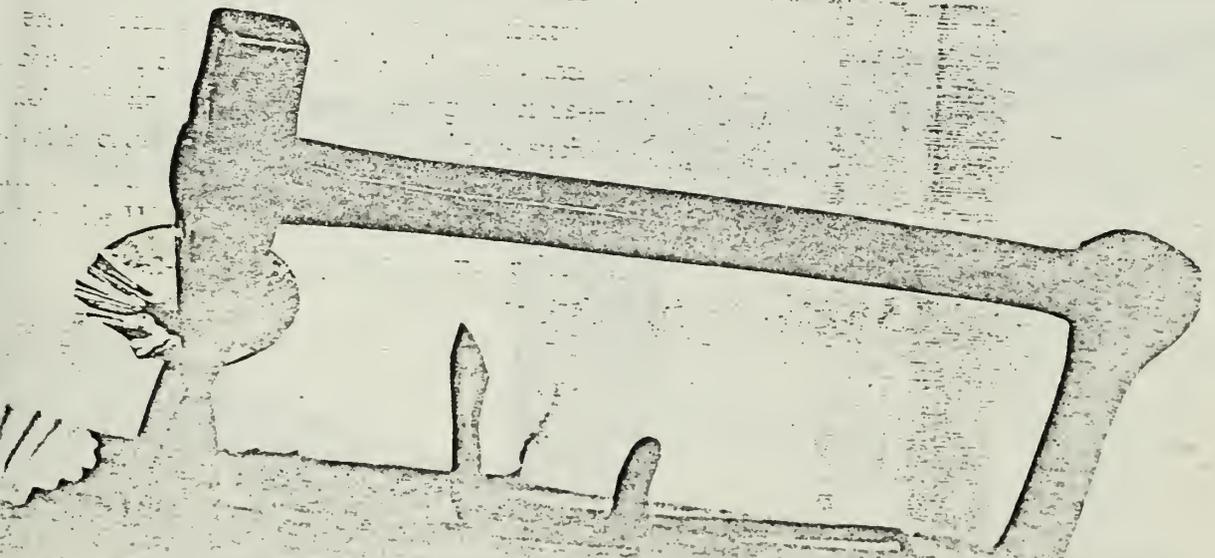
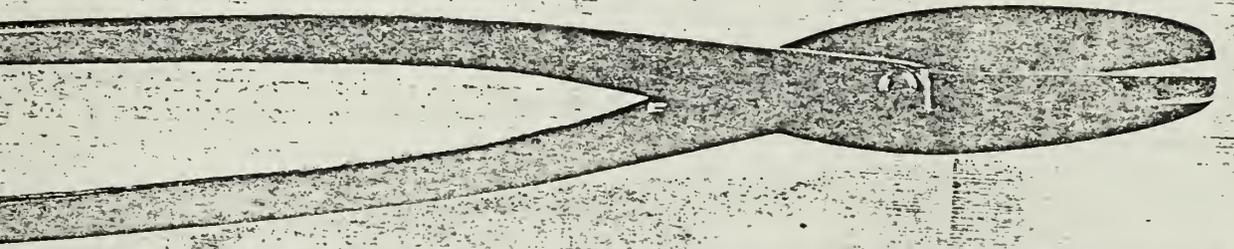
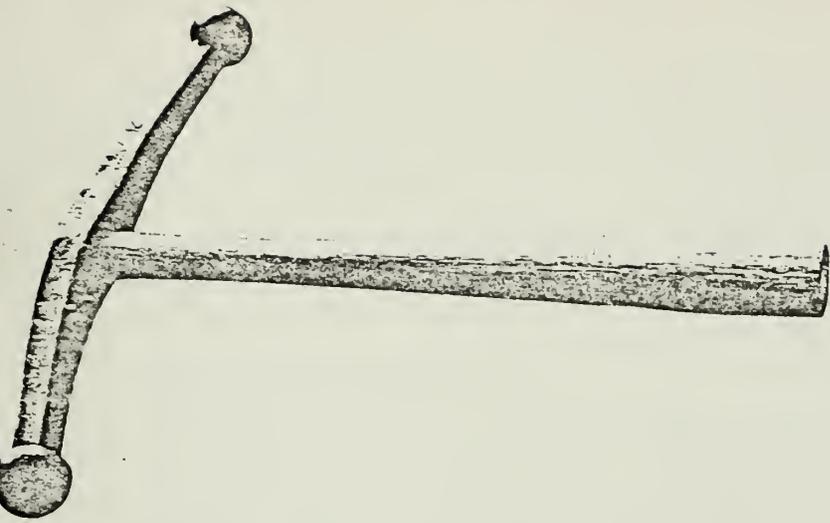
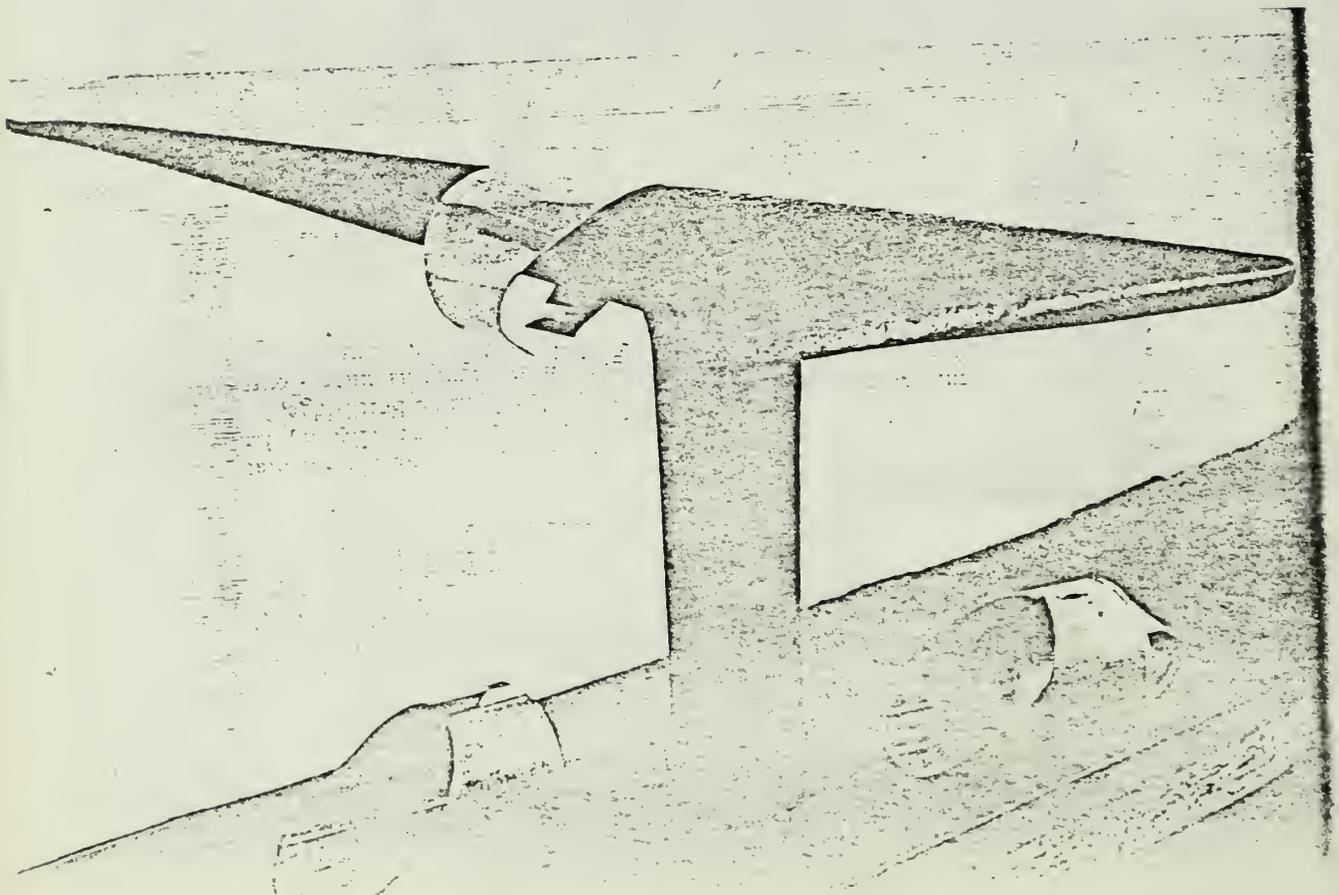


PLATE 50

Early 19th Century Tinsmith's Tools
Including Stakes, Swages, and Shears







APPENDIX I

PARTIAL LIST OF FORT VANCOUVER BLACKSMITHS

At the request of National Park Service archeologists who desire the information in order to help date remnants of "country made" blacksmith tools marked with initials, there follows a list of all employees identified as blacksmiths on the Fort Vancouver rolls from 1828 to 1852 examined by the writer. Prior to Outfit 1837 the district statements (or rolls) seen by the writer did not note the occupations of tradesmen except under special circumstances, such as the granting of a "gratuity" or extra pay when, say, an ordinary laborer served as a blacksmith, baker, etc. Before Outfit 1837, therefore, the annual lists given below are largely fragmentary and constructed from scattered miscellaneous sources. But lists of employees are to be found in more than one place in the Company's records, and probably rolls exist that will permit the naming of the blacksmiths for all the years from 1825 to 1852. After the latter date there does not seem to have been a blacksmith at Fort Vancouver.

Outfit 1828 (men not identified by trade)

Francois Bouvet. Ten pounds extra wages for blacksmith's service.

William Canning (William Cannon). Not identified as a blacksmith, but had been on Fort Vancouver roll since at least 1825; known from other sources to have been a millwright and blacksmith; remained on Fort Vancouver roll through Outfit 1835, at which time he was earning £45 per annum; during Outfit 1833, at least, he was at the Fort Vancouver sawmill.

André Lachapelle. His wages at this time were £22 per annum, more than those of an ordinary laborer. He may not have been a blacksmith at this time, as he was not identified as such until Outfit 1837.

Outfit 1829 (men not identified by trade)

André Lachapple [sic]. £22

Outfit 1830 (men not identified by trade)

George Folster. Listed under "General Charges."

André Lachapelle. £25

Outfit 1831 (men not identified by trade)

George Folster. £30

André Lachapelle. £25

Outfit 1832 (men not identified by trade)

George Folster. £30

André Lachapelle. £25

Outfit 1833 (the following men listed as blacksmiths)

Jean Racine dit Noyer.

John Alexander Saunders (assisting)

Greely Sargent

Isaac Thibault [or Thibeault]

Outfit 1834 (men not identified by trade)

André Lachapelle. £30

Jean Racine de Noyer. £30

John Alexander Saunders. £17

Greely Sargent. Served only 6 months; sent to Oahu 12/1/34.

Isaac Thebault [sic]. £40

Outfit 1835 (men not identified by trade)

William Canning. £45. Possibly still at mill.

George Folster (b). £30

André Lachapelle. £30

~~John Alexander Saunders.~~ £17

Outfit 1846

George Aitken. £35

Joseph Ovide Beauchamp. £30

George Folster (b). £30

Thomas Scott. £30

Outfit 1847

George Aitken. £35

George Folster (b). £30. Does not appear on rolls after 1847.

Joseph O. Beauchamp. £30

Outfit 1848

George Aitken. £30. Went to California; wages to March 1, 1849.

Outfit 1849

Kaihé. £25

Outfit 1850

Kaihé. £8.6.8. Wages to March 1, 1851.

Jonathan Moar, Jr. £25. Listed under "General Charges."

Outfit 1851

(No blacksmiths listed.)

Outfit 1852

David Smith. £48

Outfit 1853

(No blacksmiths listed at Fort Vancouver, but one page of the departmental personnel list for that year does not give the posts at which the men were stationed; thus there is a slight chance that there actually was a smith at the old Columbia depot.)

Outfit 1854

(No blacksmiths listed at Fort Vancouver.)

Outfit 1843

Joseph Ovide Beauchamp. £30. Listed under "Columbia Charges."

Kenneth Campbell. £30

James Dickson. £12.10.0. Returned to England, 10/31/43.

John Flett (c). £30.

George Folster (b). £20

Andrew Louttit. £30

Joseph Plouffe. £22. Listed as a "boute" in H.B.C.A., B.239/1/14,
MS, p. 63.

Outfit 1844

George Aitken. £35

Joseph Beauchamp. £30

Kenneth Campbell. £30

George Folster. £25

Andrew Louttit. £8.15.0. Went "home" from York Factory
on the Prince Rupert, fall 1844.

Thomas Scott. £30. Listed under "Columbia Charges."

Outfit 1845

George Aitken. £35

Joseph Ovide Beauchamp. £30

George Folster (b). £30

Thomas Scott. £30

Outfit 1840

James Dickson. £30

John Flett. £25. Transferred to steamer Beaver after seven months.

George Folster. £40

André Lachapelle. £30

Allan Morrison. £25

Andrew Louttit. £30. Listed under "Columbia Charges," perhaps not at Fort Vancouver.

Outfit 1841

James Dickson. £30

George Folster. £40

Andrew Louttit. £30

Allan Morrison. £25

George Aitkin. £35. Listed under "Columbia Charges."

Kenneth Campbell. £28. Listed under "Columbia Charges."

Outfit 1842

James Dickson. £30

George Folster B. (sic). £20

Andrew Louttit. £30

Joseph Plouffe. £22

Kenneth Campbell. £28. Listed under "Columbia Charges."

Outfit 1836 (men not identified by trade)

William Canning. Drew only £8.0.3 in wages, so probably retired during the year.

George Folster (b). £30

André LaChapelle. £30

John Alexander Saunders. £17

Outfit 1837

James Dickson. £30

George Folster (b). £30

André LaChapelle. £30

John Alexander Saunders. £17. Listed as "middleman."

Outfit 1838

James Dickson. £30

George Folster. £40

André LaChapelle. £30. Listed as a middleman, but this description probably was an error.

Jean Baptiste Roi. £30

John Alexander Saunders. £22. Listed as middleman.

Allan Morrison. £25. Listed under "general charges."

Outfit 1839

James Baker. £22

James Dickson. £30

George Folster (b). £40

André Lachapelle. £30

Allan Morrison. £25

John Alexander Saunders. £22. Listed as a middleman.

John Flett. £25. Listed under "general charges," perhaps not at Fort Vancouver.

APPENDIX II

Glossary of 19th Century

Blacksmithing Terms

GLOSSARY

Bending

The blacksmith made bends of every description on most of the work he performed. Cold bending was rarely used except on small items where strength was not necessary. A round bend can be shaped over the horn of the anvil, or, in the case of making rings, on the floor mandril. Square bends are shaped over the edge of the anvil face or in the vice. There are special bending tools, such as a forked-like tool which fits into the hardie of the anvil. A scroll fork, as the name indicates, is for forming scrolls. These can be of different sizes and shapes.

Beveling

This is hammering, while hot, the end or edge of a bar or rod to form a diagonal surface. Useful in welding.

Drawing Down

This is the process of increasing the length of a piece of metal and at the same time reducing its cross section. This is also referred to as fullering. For example, the flat blade of a hoe was drawn out to taper its bottom edge. A fuller is used when drawing out large pieces.¹

Flux

Used in welding. It may be borax or clean sand. See welding.

1. The method of using this tool is described under Fuller.

Hardening and Tempering

Forged tools are not hard enough to hold or take a finely ground cutting edge. They had to be tempered to make them tough enough to be used for cutting. Watson describes the process of hardening and tempering:

Tempering was a two stage process, carried out after the blacksmith had forged and shaped the tool and made a shank on its end to fit into a wooden handle. The finished tool was heated and plunged at once into cold water, making the tool very hard but brittle—so brittle that if the tool was used for work at this point, pieces of iron would chip off.

The second stage was known as "drawing the temper." The heat-treated tool was once more put into the fire and allowed to soak up heat slowly until about two inches of the tip was a bright cherry red. Then it was immediately quenched in the slack tub. The tool was still hot—for this quench simply meant sudden cooling to a degree, not until stone cold. The iron now had a distinctive colour, a colour that would change as the iron cooled. The blacksmith now had to watch the colour carefully, so he brightened and cleaned the metal by rubbing it with a piece of old brick. As the iron continued to cool, it showed a band of different colours, moving slowly toward the tip of the tool. The band ranged from light yellow to straw, to brown, to purple, and then, at the tip, to blue. When the colour that the smith wanted for the particular tool reached the tip, he again plunged the iron deep into the slack tub, this time swirling it around to ensure even and complete cooling. Each type of tool required its own temper, as represented by the colour of the iron during tempering. Tempering, then, meant reducing the hardness of a metal to a fixed point: in no case, however, did the smith draw any more temper than was absolutely necessary, since this softened the tool again.

Hardening and tempering were essential and a blacksmith had to know thoroughly the various stages as described above.

Shoulder

This is the lower surface formed by the difference in height of surfaces on a piece of iron; the higher surface is known as the "boss."

Twisting

For decorative purposes, a series of twists are made in iron rods, such as for fences, gates, lattice work. This could be done in two ways, placing the rod in the vice, while heated, and twisting the extended end with a pair of tongs; special twisting bar, of different sizes depending upon the size of the rod, were used. This was a straight rectangular iron bar with one or more square holes in the flattened center. The bar to be twisted was placed in the square hole and, grasping the two handles, the iron was twisted.

Upsetting or Jumping Up

This operation is used to thicken, or bulge, iron. It is the reverse of drawing down. It may consist of thickening a portion only, such as the middle or end, or both ends. The operation is performed by heating the iron to a yellow heat, or what is named a whiteheat, and placing one end upon the anvil or upon the ground, and striking the other with 3 or 4 hammers, as required. This operation was used extensively in making bolts; to first form the head before finishing its shape in a heading tool.

Welding

This is the process of joining, or the fusion of two pieces of metal by heating and hammering. Smith describes it:

...The metal must be kept clean and every effort made to prevent scales from forming, which impair proper welding. When heated, iron and steel form scales. This is brought about by the oxygen in the air attacking the metal, causing oxide of iron to appear. These are small particles of iron that have become oxidized and have a higher melting point than the iron or steel itself.

The melting point of the scales can be reduced by the use of fluxes.

...The flux helps prevent the oxidation of the metal;...

Fluxes, such as borax., and clean sand, are put sparingly on the metal just before the welding heat is reached. The flux lowers the melting point of the scale, allowing the scale to run off, and at the same time serves as a prophylactic, sealing out the air which would cause more oxide of iron to form. After the flux is applied, the metal is brought to a welding heat and welded on the anvil with the hammer.

There are several methods of welding or forming the joints. Bealer describes the basic ones:

"Lap welding" is nothing more than lapping the scarfed end of one bar over the scarfed end of another to join them together at welding heat...

"Butt welding" is welding the ends of rods or bars together butt to butt, instead of scarfing them for a lap weld. Also a rod may be butt-welded perpendicularly to a flat bar. This is called a "jump weld." Generally a butt weld is undependable; most smiths prefer to lap welds. The "T-weld" is to join the end of one flat bar perpendicularly to another flat bar at a point away from its end.

A "tongue weld" is accomplished by splitting one piece of iron and tapering the piece to which it is to be joined, then inserting the taper into the split before welding.

Taking a Heat

It is very important that the smith should know the signs and the effect of burning iron and he should be able to recognize instantly the correct degree of temperature which he requires for a particular operation. Moxon describes the various heats:

Of the several Heats Smiths take of their Iron. There are several degrees of Heats Smiths take of their Iron, each according to the purpose of their work. At first, a Blood-red Heat. Secondly, a White Flame Heat. Thirdly, a Sparkling, or Welding Heat.

The Blood-red Heat is used when Iron hath already its form and size, as sometimes square Bars, and Iron Plates, &c. have, but may want a little Hammering to smooth it...

The Flame, or White Heat, is used when your Iron hath not its Form or Size, but must be forged into both;... A Sparkling, or Welding-heat, is only used when you double up your Iron (as Smiths call it) to make it thick enough for your purpose, and so weld, or work in the doubling into one another, and make it become one entire lump; or it is used when you join several Bars of Iron together to make them thick enough for your purpose, and work them into one Bar; or else it is used when you are to jon, or weld two pieces of Iron together end to end, to make them long enough;...

The blacksmith flourished as a major social force in the modern world for more than two thousand years. During forty generations of hand labor there had been scarcely a single significant change in his tools and anvil techniques, or in the smelting, forging, and treatment of iron. Then - nearly within the span of one lifetime - the vital role of the blacksmith vanished. (Watson)

APPENDIX III

FORT WILLIAM HISTORICAL PARK

THUNDER BAY

MANUAL

ON

IRON CRAFTS

BLACKSMITH -- TINSMITH

BLACKSMITH

"Smithing is an Art-Manual, by which an irregular Lump (or several Lumps) of Iron is wrought (worked) into an intended Shape." This was the definition of the craft in the seventeenth century *Mechanick Exercises*, and is essentially the definition of forging or blacksmithing--the hammering or pressing of metal, iron or steel, into required shapes. This may be done while the metal is hot or cold, as the circumstances require.

Iron

Iron was known long before the beginnings of recorded history. It is not known when it was first discovered by man. It could have been the results of an accident caused by building a fire in the locality where the earth was rich in iron ore. Bog iron or bog-iron ore is common throughout the world and supplied the ore to most of the ironworks in the early period of North America. It is a soft ore found in marshy lowlands fed by seepage from underground. As the water leaks through iron-bearing soil and rock formations, it dissolves the iron salts, which are then carried into the open air of the marsh. The decaying vegetation in the marsh, acting upon this solution, separated out the iron salts, and deposited them in the form of a reddish sludge. Pure iron, a metallic element, does not exist in a natural state.

It is combined with earth or stony substance and frequently with other chemicals. To bring it to a usable state, the iron has to be "freed" by the smelting¹ process.

The first iron furnace consisted merely of a pit dug in a hillside with an opening at the bottom to provide natural draft. A roaring fire was built in the pit and the iron ore piled on the fire. When the fire burned down the lumps of iron were removed and shaped into various objects. In flat country, the pit was built above ground in the shape of a stone tower, probably no higher than 6 to 8 feet, with a draft hole in the bottom. The use of forced draft was the first major development in iron manufacture. When it was developed is unknown but prior to 1500 B.C., the Egyptians had developed a bellows made of goat skins with a bamboo nozzle and an air inlet valve.

The development of the original furnace is generally credited to the Asiatics, who introduced the idea of adding layers of the ore and fuel mixture at the top of the fire as reduction took place. The furnace had a trough at the top from which the smelter raked the raw materials on the fire. Bellows of an improved design were used to supply the forced draft. In operating, the heel of the worker's bare foot on the downward stroke closed small holes in the top, thus forcing air into the furnace.

1. Smelt from smelten, middle Dutch or Middle Low German, to melt or fuse, usually ore. Smelter—a furnaceman who smelts ore.

On the upward stroke, as the top of the bellows was being raised by means of a string attached to a springy rod, the holes were uncovered permitting reinflation. As reduction took place, the refined iron collected at the bottom of the furnace in a spongy mass which, after a sufficient amount had been obtained, was removed and forged. This was later referred to as a single-stage reduction.

There were many variations in design of the early furnaces. The Catalan Forge was a major advance in the manufacture of iron direct from the ore. It originated in Catalonia, Spain, about 1293 A.D. This furnace consisted of a hearth or crucible in which the mixture of ore and fuel was placed. The air-blast, produced by means of a trompe² or water blower, entered the furnace through tuyeres near the bottom. Later the Catalan furnace evolved into the blast furnace.

In the fourteenth century, the wasteful and tedious method of producing wrought iron direct from the ore began to be replaced by a division of the operation into two stages. Previous to this, the single-stage reduction has been uncertain as to results and wasteful of time and materials.

The fuel used was charcoal as it ignited more easily than coal and required less air blast to reach the correct smelting temperature. Charcoal, however, imparted considerable amount of carbon to the iron.

2. An appliance for creating an air blast by means of a high fall of water; where the falling of water down a pipe draws air through openings, in similar manner to that observed by all in a wash basin or bath, and carrying it along with it, delivers a steady and equal blast at the foot of the column.

It was discovered that a second heating would serve to further refine the metal which has become so over-carburized, and the wrought iron produced by this additional working was more uniform and otherwise superior to the product of the single reduction. This second operation was ordinarily carried out in a Catalan type furnace. The height of the Catalan forge was increased and became known as shaft furnaces and gradually attained a height of 30 to 40 feet. These tall furnaces were called stuckofens. The product of the stuckofen, or blast furnace, was not malleable and ductile, and could not be hammered or forged and welded like wrought iron. It was soon discovered that the new metal could be cast into various useful shapes - the beginning of cast iron. The raw materials - iron ore, flux and charcoal - were charged in at the top of the furnace, and the air, under very low pressure was blown in at the bottom. Flux, generally lime, was added to the charge of the furnace, for the purpose of absorbing mineral impurities in the metal and running them off as the slag. While the heavier molten mass of iron settles to the bottom of the furnace, the lighter slag floats on top. This waste product is removed from the surface and the molten iron is run off into molds as pig iron. The term "pig" is derived from the appearance of the iron being run from the base of the furnace through a main sand mold into several smaller molds - like a sow and her suckling pigs. Iron also could be run off directly into special molds to cast cooking utensils, firebacks, stoves, cannon and shot.

Pig iron, suitable for casting, was too brittle for forging by the blacksmith. The cast pigs or bars were further refined to produce malleable wrought iron in an open forge called a finery or refinery. Several bars, measuring roughly six feet by six inches, are laid on end in a bed of burning charcoal where they gradually melt from the bottom up as the finers constantly stir the charge. The melting iron descends to the bottom where it comes in contact with the blast from the bellows, which has a purifying effect in reducing most of the carbon from the iron.

The intense heat and the stirring caused the melted particles to fuse together in a soft mass of wrought iron, called the "blume," or blower, from which the present use of the word "bloom" is derived. Not structurally firm enough to forge, the sponge-like bloom is removed and roughly shaped by sledges on a large anvil or iron plate. Then the hot metal is hammered into a compact form under a tilt hammer.

Charcoal

Woodchoppers felled the trees for the charcoal burners who stacked it into high piles, the logs being placed roughly perpendicular to the ground. This mass of wood was covered with an airtight blanket of dirt and charcoal dust and packed over with a layer of leaves or pine needles. Draft holes were opened in several places around the base of the pile and a chimney hole was left in the centre of the top. The fire was lit from a nest of shavings and kindling at the bottom of the chimney hole.

When it was burning strongly, the draft holes and the chimney were covered and the burner kept an eye on the process by occasionally digging small holes in the blanket of dirt to see how the burning was progressing. The burner tended the fire for days. It took three to ten days to reduce the wood to charcoal, depending upon the kind of wood and the weather. Wood has to smolder rather than burn to produce good charcoal.

Steel

Charcoal was essential in the making of steel. In the early years, steel was usually a by-product of making malleable iron. After the fourteenth century, steel was made deliberately from wrought iron, just as wrought iron was made deliberately from cast iron. The production of steel was quite simple. Bars of iron were placed in a tight iron box or furnace and packed with layers of charcoal. The furnace was sealed to keep it free of oxygen and was then fired and blown with bellows for a varying length of time, depending on conditions, heating to a high temperature. When the iron became white hot, it began to absorb the carbon from the charcoal. After the bars had absorbed the right amount of carbon, the furnace was cooled slowly and the bars removed. It took the name "blister steel," because the high heat gave it a blistered appearance. It was also called "shear steel," because the main uses were in making shears and other cutting instruments that required a hardened edge.

Although blister steel was uneven and undependable, it was highly valued since it could be hardened and tempered, whereas iron could not be. It was easily welded to iron, so that axes, plane bits, drawknives, and scissors were made of iron with a steel edge welded on.³

Rolling and Slitting Mills

Slitting mills appeared in the sixteenth century and these mills slit hot iron bars into nail rods. Rolling mills to roll hot iron bars into sheets of iron were operated in England in 1697 and may also have been in operation as part of the slitting mills in the late sixteenth century.

Coke

As much if not more charcoal was needed to produce a ton of iron as was iron ore. It is noted that an iron furnace producing 15 tons of pig iron consumed the wood of 4 square miles of forest each year. The drastic shortage of wood occurred in England in the sixteenth century. Queen Elizabeth of England issued an edict that limited cutting of forests in certain areas, as she needed the timber to build the ships for her navy. Other monarchs followed suit in succeeding generations except in America, Scandinavia and Russia. Coke made from coal appeared to several as the logical substitute for charcoal as it also consists almost wholly of carbon, however, it took many years to develop this method of making iron.

3. In the Orient and particularly in India, a greatly superior steel had been in use since early in the Christian era. This was known as Wootz steel from which the fabulous swords of Damascus were made. Despite the wide use of this steel in Europe, the secret of making

It was not until the early eighteenth century that Abraham Darby in England succeeded in smelting iron with coke. His method was improved and by the end of the eighteenth century coke had nearly replaced charcoal in Britain's iron industry. Coke was processed in an oven shaped like a beehive and accordingly became known as beehive coking oven. It was not until almost the middle of the nineteenth century that one was built in America.

The year 1733 marks the first production of iron in Canada at "Les Forges saint-Maurice (1729-1883)." John Lambert in his travels describes the forge when he stayed at Three Rivers in August 1808. The forge was about eight miles and located on the river St. Maurice. He writes:

Here the manufactories, the furnaces, forges, and work-shops; the barns, stables, and out-houses; the habitations of the superintendant and work people belonging to the establishment, with their little gardens and plantations, form altogether a small town.

...
There is one foundry, with a large furnace for the purpose of casting stove plates, potash kettles, machinery for mills, &c. I saw the process of modelling and casting, which is conducted with much skill...The men dipped their ladles into the melted ore, and carried it from the furnace to the moulds, with which the floor of the foundry was covered. After they were all filled, they took off the frames while the stove-plates and potash kettles were red hot, and swept off the sand with a broom and water. The sand for moulding is imported in casks from England...They make use of charcoal only, for melting the ore; and the neighbouring woods supply them with abundance of fir and pine for that purpose.

...
The hammers at the forges, the bellows at the foundry and some other machinery, are worked by water; only bar iron and plough shares are made at the forges. The iron is reckoned equal, if not superior, to the best Swedish iron: it is preferred by the Canadians to any other iron.

They make about 1000 stoves per annum; the small single stoves sell for 3 l. and the larger sort for 6 l. each. The double stoves, which have an oven at the top, are sold for 10 or 12 l. according to the size. Potash kettles sell from 20 to 25 l. each.

Joseph Sansom visited Three Rivers in 1820 and made the following remarks:

Near Three-Rivers is an iron-foundery, which has been worked ever since the year 1737, and the castings produced there are uncommonly neat. The ore, it seems, lies in horizontal strata, and near the surface. It is found in perforated masses, the holes of which are filled with ochre. This ore is said to possess peculiar softness and friability. For promoting its fusion, a grey limestone is used, which is found in the vicinity. The hammered iron from these works is pliable and tenacious, and it has the valuable quality of being but little subject to rust.

Iron and Steel at Fort William

"A monthly Collection of Tradesmens tools, Stationery, fishing tacklin (sic) &c. &c. issued from the Stores for the use of the Concern" recorded from September 1816 through March 1817, 1170 pounds of "Iron flat bar" and 119 pounds of "Steel" "for makg axes &c" was issued. "20 pounds of iron rod was issued in March 1817 and 33 pounds "Sheet iron." The inventory for the Provision Store in 1816 lists: "14,013 lbs. bar iron assorted," "236 lbs. bolt iron assorted," and, "236 lbs. German Steel." Only a small amount of this was kept in the Blacksmith Shop at any one time. The 1816 shop inventory lists "237 lb of Old Iron," "34 lbs. Steels," "263 lb. New Iron." The 1820 inventory: "18 lb Steel," "42 lbs Bar Iron," "147 lb. Bolt Iron," and "517 lbs Old Iron." In 1821 inventory: "11 lbs. Bar Iron," and "978 lbs Old Iron."

The day book for 1816-1817 enters the following issued to the blacksmith: 929 lbs of iron, which included bar iron; 119 lbs of steel; and 4 cases sheet iron.¹

The Product of the Blacksmith

The blacksmith was an essential craftsman to the Fort. He must be versatile. One who confined himself to the simple turning out or repairing of axes would be of limited value. It was almost endless the number of equipment of the trade that he could make: hatchets, axes, half-axes, knives, fish spears, hoes, kettles, tomahawks, awls, nails, bolts, hinges, and many other iron items. Some of this work is recorded in the existing day books of the Fort. One entry indicates sheet iron issued "for making stove funnels," i.e., pipes. Others, 74 lbs of iron and 17 lbs of steel "to make Axes;" "Recd from Blacksmith 17 Axes, wt 66 lbs;" "14 large axes;" "5 large & 1 Half Axes 25½ lbs;" "Recd from Blacksmith 103 Halfaxes, 18 Tomahawks - 210 lbs;" "The Blacksmiths finished 51 steel traps this morning and got iron and steel to make more;" "During the week, the two Blacksmiths have been employed making Beaver Traps;" and, "...Making Springs etc for Beaver Traps." Mending and repairing would be one of the required duties of the blacksmith. One entry reveals that the two blacksmith, one other worker of the Fort, and four other men mended an anchor of a schooner, and also made bolts for "the new vessel." Another entry, "The Blacksmiths repairing axes, trenches, traps etc..."

1. The term "sheet" when applied to metals, means a sheet or plate not exceeding 3/16 of an inch in thickness. "Plate" when applied to metal, means a plate or sheet more than 3/16 of an inch in thickness.

An entry indicates the steeling of axes at the forge and on the next day, "The men sharpened and handled their axes." This may account for the woodworking tools in the shop. The making of fish spears and nails is also recorded.

Farming was carried on at the Fort and horses were necessary for that purpose as well as hunting and riding. The blacksmith had to know how to shoe a horse, and this is revealed in one entry, "Robedoux and Bouchard shoeing the horses." The iron work on the wagons and sleds at the Fort would require repair or replacement from time to time. He would also need woodworking tools for this work.

The Blacksmith's Yard

The yard would be used for the shoeing of horses and oxen, and as a storage area for scrap iron, wood and fuel. In the 1820 inventory, there are 200 barrels of charcoal, each containing four bushels, and there are 150 cords of wood for making charcoal, indicating that charcoal was made at the Fort and used as the fuel for the blacksmith's forge. There is no charcoal listed in the 1821 inventory but there are 100 cords of wood for making "coals." The ashes from the hearth would have been spread in the yard and would have eventually given the yard a hard surface much more desirable than the sometime mud. This may account for the "1 demoiselle," French for earth rammer, listed in the inventories.

THE SHOP

The Forge

The forge is essential to the working of iron. Copper and other soft metals can be easily shaped when cold, whereas iron requires intense heat. Forges were constructed of various materials, brick or stone, and in various shapes and sizes, rectangular, square, or sometimes round.¹ The height of the forge varied; 2½ feet to 3 feet, depending upon the work, for heavy work, the hearth should be lower than for light work.

All forges have certain common parts. The central portion contains the hearth or fireplace. The back is generally built upright to the top of the ceiling and has attached a hovel or hood, extending over the fireplace to carry away the smoke through a chimney in the back. An iron plate with a tapered pipe in it, varying in length, called a tuyere,² is fixed in back of the fireplace. Into this tapered pipe is placed the nose or pipe of the bellows. In some forges the tuyere is lower and enters below the fireplace, which generally contained an iron grate called a "duck" nest, designed to be cleaned periodically of ashes and cinders dropped from the fire above.

The bellows is placed behind the back or sometimes at the side of the forge with its pipe fitted into the nozzle of the tuyere.

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1. Wooden forges were also constructed with a hearth of hard-packed clay.
 2. Anglo-Saxon corrupted *tuyere* into "tweer," "tue iron," "twele" or "tewel-iron."

The single action bellows is one that has only one chamber between the top and bottom wood board; a double action bellows is constructed with three boards, top, middle and bottom. The sides of either are of leather. The inventories list two bellows. A bellow often required repairs and an extra bellow would be essential to keep the shop working.

Anvil

Apparently the shop had three anvils. The 1816 and 1820 inventories record 3, the latter listing the weight of all three as 488 pounds. It is assumed that one was fairly large for heavy work, such as axes; and the other two smaller for lighter work, such as nails, bolts. It is possible that the shop had a bickern.¹ The 1821 inventory lists one anvil as weighing only 49 pounds. This would have been mounted the same as the larger anvils.

The location of the anvil is important, for a piece of iron had to be heated several times. Iron cools quickly to the point where it can no longer be worked, therefore, the anvil had to be close to the forge. The height of the anvil depended upon the size of the workman. It was mounted upon a wood block, generally a tree trunk, buried four or five feet in the ground, and secured to the log by long nails or spikes.

1. Sometimes called beck iron, bick iron, or bicker iron. It was used for forging round and hollow work, such as kitchen pots and utensils.

Bealer gives the following description of an anvil:

The forged iron that constitutes the mass and weight is called the "body." It is faced to a narrow rectangle on top, called the "face," which extends to a smaller rectangle, called the "table," which extends into the cone-shaped pointed "horn." Its square "heel," or "tail," is the portion of the face opposite the horn that protrudes over the "base." At the bottom the iron is spread by forging into the base, and this is further extended in each corner into the "feet." Between its top and base, it is shaped into a narrow portion, called the "waist." The base generally contains a hollow space about 4 inches in diameter, penetrating into the iron about 3 inches. Some anvils also have a 1-inch hole in front and in back of the waist into which a bar can be inserted for carrying or handling.

The rectangular steel face is welded to the top of the wrought-iron body in a position that leaves a $\frac{1}{2}$ or 1 inch drop from the top of the face to the top of the table. Opposite the face is punched with a hardie hole, from $\frac{1}{2}$ to 1 inch square, depending on the size of the anvil, and a round pritchel hole, usually $\frac{1}{2}$ inch in diameter.² All anvil tools, from hardie to half-penny snub-end scroll, fit into the hardie hole; the round hole is for punching or making bolt-heads or for inserting a rod around which hot iron can be bent when hammering over the horn is unsuitable.

Watson refers to the table as the "chipping block," made of wrought iron. In cutting off a piece of hot iron the work was laid out over this softer section so that the sharp edge of the chisel was unharmed when it struck through to the chipping block.

Close to the forge and anvil would be a tub filled with water for quenching hot iron, called a slack tub.

2. It is doubtful that the anvils of this period had a pritchel hole. Illustrations of early anvils viewed do not show one.

The shop had two sets of fire irons. These were generally a poker to loosen the fire by stirring the hot coal to allow the bellows to operate more efficiently; a rake to pull out clinkers, bring together or separate pieces of coal, and clean out old coal beds; and a shovel to convey the coal to the fire and to remove the ashes.

Hammers

There are several sorts of hammers used by the blacksmith. The hand hammers, so called because it is held by only one hand, were generally used by the blacksmith, with handles from 15 to 18 inches long. The sledge is the heaviest of the blacksmith's hammers, weighing from 5 to 20 pounds. Moxon defines the sledges as:

...the Up-hand Sledge, used by under-Workmen, when the Work is not of the largest, yet requires help to batter, or draw it out; they use it with both hands before them, and seldom lift their Hammer higher than their head... the About Sledge is the biggest Hammer of all, and is also used by the under-Workmen, for battering, or drawing out of the largest Work; and then they hold the farther end of the Handle with both their Hands, and swinging the Sledge above their Heads, they at Arms end let fall as heavy a Blow as they can upon the Work.

Watson relates the method of using the sledge:

The blacksmith's helper was known as a striker. He stood facing the smith on the other side of the anvil, ready with his heavy sledge to lay on blows as the blacksmith directed...By lightly tapping the spot with his small hammer, the blacksmith showed his striker where he wanted the sledge to strike...When the smith wanted the striker to stop he used the universal signal: a light tap of the hammer on the anvil to one side of the work.

The head of a hammer consists of an eye in which the handle is inserted, the striking end or face and opposite the face the peen.¹ The mass of the head was made of wrought iron and, like the anvil, a small steel plate was welded to the face and peen. The faces of forging hammers are not flat. They have a rock; i.e., the center is slightly higher than the other edges of the face. The edges are beveled so the smith will be less apt to show a ring or mark on the metal he is hammering.

There are three types of sledges, the straight peen sledge, the cross peen sledge, and the double face sledge. Diderot mentions three kinds of hand hammers. The first properly called the hand-hammer with heads slightly less than the sledges. The second, the bickern hammer, so called because it was used more often on the bickern; and was the smallest of the hand hammers. The third was called a round headed hammer. Felibien states the latter was used for shaping round and semi-round pieces. There are also riveting hammers. Riveting is using rivets (iron rods) inserted through holes in two pieces of iron, the ends of rivets are bradded (spread out) to prevent it from being pulled out.

The 1821 shop inventory lists 4 sledge hammers, 7 anvil hammers and 3 bench hammers. The bench hammers could have been the smaller type of anvil hammers or possibly have included carpenters hammers if the smith performed any work in which wood was a part of the object.

1. Also spelled pen, pein, pene.

The anvil hammers would have consisted of a hand hammer and could have included other types of blacksmiths hammers used on the anvil. There are two types of hammers designed for smoothing off flat work in the finishing operation. The square and round flatters, as their names suggest, are used to flatten and smooth straight, wide, and flat surfaces. The set-hammer is used in finishing corners and parts that cannot be reached with the flatters. The faces of both these hammers would be steeled, the opposite end would be iron. These are placed on the iron and the non-steeled head is struck with another hammer. The 1816 inventory lists 3 "chasses," and the 1820 inventory 4 "chasses," i.e., set-hammers. Diderot illustrates 3 types of set-hammers: square set hammer (chasse quarree); beveled set-hammer (chasse a biseau); and hollow set-hammer or set-hammer with a fillet (chasse creuse ou a fillet).

Vices

The 1816 inventory lists 2 large bench vices, 1 small bench vice and 2 small hand vices.

The bench vice is one which is attached to the bench. The leg or foot¹ vice was important to the blacksmith and is illustrated in various eighteenth and nineteenth century publications.²

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1. Also referred to as a post vice.
 2. The modern leg vices are almost the same as illustrated in these early publications.

It is attached permanently to the bench, the "chops" (jaws) and screw above the top; from the back extends downward a "leg" or "foot" embedded in the floor; so the vice is fastened to the bench and also in the floor and is, therefore, steadier and more secure. It is in this vice that heavy bending and hammering is performed.

The small vice was probably a screw clamp type and used for lighter work. It could be moved from place to place on the bench.

Moxon defines the hand vice as:

Of the Hand-Vice are two Sorts, one is called the Broad chapt Hand-Vice, the other the Square Nos'd Hand-Vice. The Office of the Hand-Vice, is to hold small work in, that may require often turning about; it is held in the left hand, and each part of your work turned upwards successively, that you have occasion to file with your right. The Square-nos'd Hand-Vice is seldom used, but for filing small Globulous Work, as the Heads of Pins that round off towards the Edges, &c. And that because the Chaps do not stand shouldering in the way, but that the flat of the File may the better come at the Edges. Their Chaps must be cut as the Vice aforesaid, and well tempered.

He recommended the chops of the foot vice "...must be cut with a Bastard Cut, and very well tempered;.." The bastard cut is one which the surface of the inside of the chops are scored criss-cross to form a series of coarse teeth.

The hand-vices illustrated by Diderot in his plates of the "Serrurerie," the locksmith, who also made all sorts of other iron-work, derive their name from either their shape or from what they were intended to hold.

He illustrates "Tenailles a chanfrin," which may be translated a beveled vice. These are not held in the hand but in the larger shop vice. Their purpose was to hold the piece at a 45 degree angle so that it could be filed in a chamfer. In some beveled vices, the jaws or chaps were steeled and teathed.

The "Tenailles-a-liens," took its name from the object it held, a band or strap vice. The pin, which holds the two sections of a hinge together, may be either flush with the hing or often have a rounded or decorated tip. The vice to hold this pin was called a "Tenailles a bouton," or hinge-pin vice, so that the tip could be filed. It is also held in the larger vice.

"Tenailles a rouleaux," or scroll vices, as the name indicates, is used to hold scroll-work but could also be used for larger pieces. The "Tenailles-a-vis," literally translated as vice with a screw or screw vice; is what is commonly called a hand-vice. It is very similar to hand-vices illustrated in late nineteenth and early twenty century tool catalogues. This was also used to hold small pieces to be filed.

In his plates of the "Taillanderie," (tool maker) he illustrates similar vices. The hand vice illustrated has chaps contrary to the base of the vice. It appears this could have been held by hand or in the large vice. There are also hand vices for forming the heads of nails.

The 1816 inventory lists "18 Cloatiers; 1820, "17 Cloatieres," and 1821, "18 Nail boards." This is a phonetic spelling of the French word - cloutier, nail header. Nails were certainly essential to the Fort for building and repairing. Nail headers varied in size and shape. They could have a square or round holes or a series of holes, size depending upon the type of nail to be made. The making of nails is quite simple, Tunis states, "Making a nail took much less time than it takes to read about it." An early nineteenth century French Dictionary stated that a good nail-maker could make between 12 and 20 nails a minute, depending on the size.

Smith describes the nail rods, "The rods varied in thickness, according to the kind of nail required. Most of them were about $\frac{1}{4}$ inch thick, and up to three or four feet long."

The nail rod was heated and then with the hammer the shank of the nail was shaped and pointed on the anvil. He laid the rod across the hardie and with the hammer partly cuts through the iron. It is then inserted in the header, where it is twisted off at the cut. The cut end is then struck glancing blows with the hammer to form the head. He always had a number of nail rods heating in the fire at one time. When he inserted the nail rod into the header and broke it off, he immediately replaced it in the forge to reheat, thus as he finished a nail, he always had a heated rod ready to make another.

Tongs

Tongs are almost as equal in importance to the blacksmith as the hammer and anvil, for without them he could not hold the hot iron. Tongs vary considerably in size and shape and some were made for particular purposes and shaped to hold special work. Their length varied between 16 and 36 inches. The greatest variation is found in the shape of the jaws. Flat jaw tongs would provide a firmer grip on a flat object than a round jaw tong would, and wide jaws would better hold a wide piece of metal than narrow jaws. Many blacksmiths designed and made their own tongs as probably did the blacksmith at Fort William. The tongs would be kept in a tool rack close to the anvil and forge.

Neither the 1816, 1817, nor 1820 inventories list any tongs. It is most certain that the smith could not operate without them. The 1816 inventory lists "25 finger Nippers," and the 1820 inventory lists "36 Foot Nippers." The inventory of 1821 lists "37 Pair of Tongs." In all probability the finger and foot nippers refer to tongs.

Cutting Tools

Iron may be either cut hot or cold. The cutting tools are the hand chisels; the hot and cold sets,¹ which are handled chisels; the anvil hardie or cutter; shears; saw, depending upon the material.

1. Also referred to as hot and cold sates.

There are two types of hand and handled chisels used in the forge; the cold chisel for cutting cold material and the hot chisel for cutting hot material. The cold chisel is always thicker in the blade than the hot chisel. The sides are ground to an angle of about 60 degrees with each other to form a good cutting edge. It is made blunt to give it strength to cut the cold material. If the edge was too thin, it would bend.

The hot chisel has a thin edge and is ground somewhat thinner than cold chisels with the sides at an angle of about 30 degrees. It is made thin and sharp so that it will penetrate the hot metal rapidly and thus prevent the loss of temper, as it is not tempered as hard as the cold chisel. It is thin since great strength is not required to cut the metal softened by heat. The hot chisel should never be used on cold material, as its edge will be turned and ruined; nor should the cold chisel be used for cutting hot stock, as the heat will soften its edges, making it unfit for cutting cold stock.

The material to be cut, either hot or cold, is placed flat on the face of the anvil; the worker holds the chisel over the place to be cut and with the hammer in the other hand strikes the head of the chisel. In cutting thick iron plate cold to any figure, the figure is drawn or scratched upon the surface of the plate and if large, placed on the anvil; if small, on the stake; the chisel is placed in the left hand with its edge set upon the mark and with the hammer in the right hand, it is struck until the plate is nearly cut through or leaves a thin portion.

If the iron was cut through, the face of the anvil, being steel, would break the edge of the chisel and for this reason when the cut comes near the underside, it is struck only with light blows. When this is accomplished, the part intended to be removed can be broken off with the fingers or with a pair of nippers, or by pinching the plate in the vice, with the cut part close to the chaps, and then wriggle it, until it breaks off.

To cut iron bar cold, the bar is laid on the anvil with the cold chisel edge on it and the head is struck with a hammer; this nicks the bar. The bar is then rotated slightly and another blow struck, and so on rapidly until there is a sharp indentation around the bar. It is then struck sharply across the edge of the anvil and snapped in two at the nicked section.

The handled chisels, generally used for larger stock, are called hot and cold sets. The handle may be of wood, iron, with withe or hazel or other softwood wound around it. The hot sets have handles similar to hammers but without wedges which would shrink and become loose, since they are subjected to more heat. When the handle becomes loose, striking its butt end upon the anvil jumps the set down to a firm hold, ready for immediate use.

The operation may be carried out with two or three men. One worker holds the stock and chisel and another worker strikes the chisel with the sledge.

The hardie or anvil cutter has a shank which fits in the square or hardie hole in the heel of the anvil and is used for cutting off length of metal, hot or cold.

The metal is laid across the edge of the hardie and struck with a hammer. It is reversed and hammered again until a slight tap will break it.

Thin sheet iron and iron wire can be cut with shears made in proportion to the thickness of the iron bar to be cut. The long sharp pointed hook part of the handle was placed in a bench or a block to hold it firm.

The hack saw is the common type of metal saw. The work is held in the vice; the left hand holds the frame at the end and above the blade, so that if the saw is brought back too far, the hand will not be injured by the work or the vice. The right hand, holding the handle, pushes and guides, while the left hand balances the saw. The teeth are pointed away from the handle so that it will cut on the forward stroke. There are many varieties and makes of hack saws.

The 1816 inventory lists 10 cold chisels. No hot chisels are mentioned. It is possible that the shop did not have any but it does not appear likely. Along with the cold chisels were listed "2 Trenches," 2 hag iron. The trenches could be misspelled. The French word "tranche" may be translated as - chisel, anvil cutter; "tranche a chaud et a froid, hot and cold set." The 1820 inventory lists "11 trenches" along with the cold chisels and hag. The word "hag" is defined by The English Dialect Dictionary as "an inverted chisel which a blacksmith puts into his anvil when he wishes to cut anything off." The word was used in Yorkshire in the neighbourhood of Sheffield.¹

1. This may indicate that one of the blacksmiths was from Yorkshire.

The 1816, 1820, and 1821 inventories list "1 Iron Frame Saw." This is interpreted to be a hack saw or blacksmith's frame saw.

The inventories list "1 pr. Saissailles," "1 pr. Scissailles." This is no doubt the phonetic spelling of the French word "cisailles" - metal shears.

The 1816 and 1820 inventories list "1 pr pincers," the latter listing the price as 1s 3d. The 1821 inventory lists "1 pr nippers" 1s 3d. Both pincers and nippers are very similar and can easily be misidentified. The blacksmith did shoe horses and he would have had need for pincers to remove the nails and shoes from the horses' hoof. Nippers are a holding tool.

Screw Plates

Screws and nuts are very essential to the blacksmith in joining metal parts. The tools for making screw threads by hand are taps and dies.

The shop had "2 Large Screw Plates," "1 Mid" screw plate "broken," and "1 polished" screw plate. The "plished" screw plate may have been a small one as it was valued at 6s, the larger ones at 20s each. The tools for making screw threads by hand are taps and dies. Taps are used to cut the female thread, the internal thread or the thread in the nut. Dies are used for cutting male threads, i.e. external threads. A die is a hole pierced in a piece of steel, around the interior of the hold screw-threads are made with a tap.

Moxon defines the screw-plate as:

...a Plate of Steel well temper'd, with several holes in it, each less than the other, and in those Holes are threads grooved inwards; into which Grooves, fit the respective Taps that belong to them. The Taps that belong to them, are commonly made tapering towards the Point...
These are the most Essential Tools used in the Black-Smith's Trade...

A screw has three essential parts: 1. the screw-pin, that part which has the threads; 2. the shoulder, that part which does not contain any threads and is between the threads and the head; and 3. the head.

The head of the screw might be either round or square but in most the shoulder had to be square near the head so that when it was placed into a square hole, it would not twist about when the nut was tightened. To make the screw, a square bar or rod of iron, as near the size of the head of the screw-pin as possible, was chosen. This was placed in the forge and brought to a flame heat. The portion intended for the length of the shank was laid upon the anvil and hammered down to the intended thickness. This first hammering made two sides of the shank, the one that was on the anvil and the side beaten flat with the hammer. It was reheated and one of the unwrought sides was laid on the anvil and the process repeated. Thus the shank was formed with four flat sides. Part of the shank at the end was hammered down, i.e., drawn down, and rounded to form the screw-pin. The rod was then cut just above the shoulder of the shank with a chisel. This portion above the shoulder made the head.

The shank, with the screw-pin down, was placed in the vice so that the shoulder fell flat upon the chaps and then the head was hammered out, i.e., upset. The shoulder was filed square and the head filed either swaure or round. The screw-pin, that part upon which the threads were to be cut, was filed tapering toward the end. A tapered end was easier to insert in the screw-plate. The rule for tapering was to measure how deep the inner grooves (between the threads) of the screw-plate lie in the outer threads, and file the end of the screw-pin slightly smaller than the rest of the screw-pin. The outer threads of the screw-plate must make the grooves on the screw-pin and the grooves of the screw-plate finish making the threads on the screw-pin.

To make the threads on the screw-pin, a hole in the screw-plate was chosen with the diameter of its hollow grooves (between the threads) equal to the diameter of the screw-pin, but not one whose diameter of the outer threads was equal to the diameter of the screw-pin, in this case the screw-plate would turn about the screw-pin but not cut any grooves or threads. When the proper hole in the screw-plate was determined the shoulder of the intended screw was placed in the vice head downwards with the screw-pin upright above the chaps; the handle of the screw-plate was held in the right hand and its hole laid flat upon the screw-pin; then the handle was turned evenly about toward the worker from right to left hand; thus the outer threads of the screw-plate cut grooves into the screw-pin, and the substance of the iron in the screw-pin filled up the grooves of the screw-plate and formed the threads.

The screw-tap that was used to make the corresponding threads in the nut must be the same size as the screw-pin. This was determined by trying the tap in the same hole in which the threads of the screw-pin had been made. The intended nut was placed flat in the vice with the hole upright and the tap placed upright in the hold. Then with the tap wrench, the tap was turned in the hole and the threads were made.

There were also adjustable screw-plates in which the die could be opened or closed or in which various size dies could be inserted. These were used to cut larger threads and was used in the same manner described.

Punches and Drifts

The blacksmith shop had "3 Square Punches," "3 Round Punches," and "28 Assorted Punches." The latter probably included several drifts.

Punching is an important operation. There are many cases where the punch is desirable, as in punching eyes for axe handles, or for making holes for riveting. Punching involves the forcing of a cold punch through hot metal. The advantage of hot punching over drilling is that no cutting away of the metal is necessary and the finished job is stronger. However, punching, unless carried out properly and carefully, tends to split the metal.

There are commonly two types of punches. The hand punches, with various shaped points, held in the blacksmith's left hand and driven into the stock with a hand hammer; and handled or eye-punches, held by the handle in the right hand by one worker and is driven into

the work with the sledge by another worker.

Nicholson describes the method:

To punch a hole. Take a punch of the size and shape of the hole required, the point or narrow end of it must be hardened without tempering, as the heat of the iron will soften it sufficiently and sometimes too much, and then it must be re-hardened; if the work is not very large, bring the iron to a blood heat, but if very large, bring it almost to a flame heat, and lay it upon the anvil: and place the point of the punch at the spot where the hole is to be made, then with the hammer punch the hole. If the work is very heavy, fix the punch in a wooden rod and place it on the intended situation of the hole; let another person strike till the punch is forced about half way through, then reverse the iron and punch through on the contrary side; the hole is afterwards smoothed, and perfected by a mandrill being driven through. But in punching take care to plunge the punch into water as often as it is heated, or as often as it changes colour, in order to re-harden it, otherwise it will spoil both the work and the punch.

Punches are circular, square, oval, oblong, and wedge (flat) shaped. The counter-sink punch is used for counter-sinking holes for screw heads and rivets. Round and square punches, as the name indicates, are used to make round or square holes. The center punch is used for marking on the iron the place to be cut, punched or drilled. There are also eye punches that are rodded as swages and fullers.

Drifts are used to finish holes that have been punched smaller than the finished dimensions. They are tapered or parallel tools having circular, square, oblong, elliptical, or polygonal cross sections, corresponding to those of the finished holes. There is no limit to the forms that may be made and used.

Drifts are smooth, and, being driven through the punched holes, enlarge, shape and smooth them while the metal is red-hot.

Mandrels

The 1816 inventory lists "23 Mandrins," the 1820 inventory has "15 Mandrines," "5 Small Mandrines," and "1 Bellow pipe do." The French word "mandrin" has several meanings - mandrel, drift, punch. Diderot defines the word to indicate drifts and illustrates them in his plates of the locksmith. The "1 Bellow pipe do" appears to clearly indicate a form of shaping mandrel. Pipe or nose of the bellows is that portion that is placed in the tuyere of the forge. The cone mandrel is used for rounding or truing rings. The heated stock is forced down on the cone. Cones vary in size, from 32 to 54 inches high; 8 to 16 inches diameter at the base; 1 to 2 inches diameter at the top and weigh from 55 to 200 pounds. There are also rod and cone shaped mandres which fit into the hardie hole of the anvil. Generally a blacksmith had need of only one cone mandrel. It would be difficult to assign a meaning and function to all the "mandrins."

Files, Rasps and Rubber

A file is a metal bar, usually of hardened steel, having one or more of its surfaces covered with a series of raised cutting edges or teeth, designed to cut by abrading. The teeth are indented by chisels before the metal is hardened, a highly specialized hand process.

A file differs from a rasp, in having the furrows made by straight cuts, either single or crossed, while the rasp has coarse single teeth raised by the pyramidal end of a triangular punch. The rubber is aptly defined by Moxon as a large rough or coarse-toothed file, Diderot illustrates several rubbers (quarreau or carreau) and states that they are square iron, from 2 to 2½ inches thick and 16 to 20 inches long; and have a wood handle. They are used for roughing down a piece of work. They derive their numerous names from what they were used on; they shape; and, in some cases, the type of cut.

Files were used as trade items and this explains the great number at the Fort. The blacksmith would not have needed the well over 100 files listed in the 1820 and 1821 inventories, and why this many were in the shop cannot be explained. Those listed in the shop were: pitsaw, tennant, hand saw, and frame saw files. As the name indicates these were for sharpening saws; tennant is an old name for tenon saw. Others were: round, half round, flat, 3 Square (triangular), length from 7 to 13 inches. There are numerous other references to files at the Fort in the 1820 inventory: flat bastard files, from 6 to 14 inches long; rat tail; "X cut Saw;"¹ whipsaw and half round polished files; flat smooth files; wood rasps; flat files, 6 to 14 inches; flat polishing files; and locking saw files.

Moxon explains the blacksmith's use of the file:

Of Filing in General

The several sorts of Files that are in common use are the Square, the Flat, the Three Square, the Round, the Thin File, &c.

1. Cross cut saw.

All these shapes you must have of several Sizes, and of several Cuts. You must have them of several sizes, as well because you may have several sizes of work,.. And you must have them of several Cuts, because the Rough-tooth'd File cuts faster than the Bastard-tooth'd File, the Fine-tooth'd File faster than the Smooth-tooth'd File.

The Rough or Course-tooth'd File (which if it be large, is called a Rubber) is to take off the unevenness of your work which the Hammer made in the Forging; the Bastard-tooth'd file is to take out of your work, the deep cuts, or file-strokes, the Rough-file made; the Fine-tooth'd file is to take out the cuts, or file-strokes, the Bastard-file made; and the Smooth-file is to take out those cuts, or file-strokes, that the Fine file made.

Thus you see how the Files of several Cuts succeed one another, till your Work is so smooth as it can be filed.

Iron Brace

The 1816 inventory lists "1 Iron Brace for repairing Stoves," the 1820, "1 Brace for Stoves," and the 1821 inventory: "1 Brace & Bitt," "1 Erace & 1 (bit) for stoves." The latter indicating a boring tool. The brace is a tool for boring, consisting of a chuck or pad for holding the bit at the foot, a head at the top for a handhold, and between the two a crank for rotating. The bit is an interchangeable tool for boring, reaming, and other purposes, designed to be fitted into a brace. It may be that the brace and bit for repairing stoves was used to bore holes for patch-work so that it could be riveted, for example, to the stove pipe. The other brace may have been for wood.

Bow Drill¹

The 1816 inventory lists, "1 drill & Brace Complete," 1820, "1 Drill and Bow, not completed," and, 1812, "1 Drill bow, box & breast plate." The bow drill, as the name implies, is operated with a bow. The body of the drill consists of a cylindrical stock similar to a spool of thread, around which the bow-string is wound, mounted on a steel rod of which the lower end holds the bit, and the upper end carries a head or nave by which the stock is held and pressed against the work. On hard material the stock is pressed against the work by a "bib" or breast-plate. This is usually a small metal plate curved to fit the chest to which it is secured by straps. The outer surface of the plate is a pad of metal containing a shallow hole which receives the blunt point of the upper end of the revolving steel rod.

A mark is first made on the iron with a center punch where it is to be drilled. The drill will find and commence drilling inside this depression made with the centre punch and without it accurate drilling is impossible. The worker places the bit end of the drill in the place punched, coils the cord of the bow around the drill-barrel and places the other end of the drill in the hole of the breast-plate secured to his chest. By working the bow back and forth, the worker causes the drill to turn rapidly, first one way then the other, thus drilling a hole in the iron.

Fullers and Swages

Although not listed in the inventories by these names, they may have been included among the 23 mandrils listed in 1816. They are small tools and very useful to the blacksmith.

Both the fuller and swage generally consist of a matching bottom and top tool. The essential difference is that the fuller makes a round groove or hollow spreading the metal in one direction only - it reduces the metal at some point; whereas the swage, although used for a variety of purposes, is mainly for finishing round material. The upper tool is furnished with a handle like a hammer which applies the force upon the heated metal held on the lower tool. The latter is held in place by a square stem or shank which extends downward and fits into the hardie hole in the tail of the heel of the anvil.

Fullers

The top fuller may be used with its matching bottom tool or can be used by itself. If shoulders are wanted on both sides of the metal, top and bottom fullers must be used; but if only one shoulder is required, either fuller will serve. The heated iron and top fuller are held by one worker while another strikes the fuller with a sledge which causes it to sink into the metal.

Swages

Swaging refers to the method of rounding the cross-section of metal. In light of swaging the bottom swage only need be used. The heated metal is placed in the hollow and, as it is continually turned, is hammered. There are hundreds of different kinds of swages.

Two most useful ones for the blacksmith at Fort William would have been a bolt head or nut swage, as the name suggests, for making bolt heads and nuts, and the common type swage or rounding tool, for rounding flat iron.

Measuring Devices

The shop had "2 pr. iron compasses" and "1 Iron Square."

A compass consists of two straight and equal legs connected at one end by a movable joint. Its main purpose is to take measurements and to describe circles. Size of leg varies from 4 to 30 inches.

The square was probably an "1" shape, and used for scribing a right angle as well as marking out straight lines and measuring.

Screwdriver

The shop had one screwdriver or, as it was sometimes called, turnscrew. The tool generally consists of a steel blade ground at one end to a flat edge for fitting into the slot on the head of a screw in order to turn it. The length of the blade varies from 2 to 24 inches, depending on the use of the tool. In all but the smaller sizes, the flat heel of the blade, just above the tang, is fitted into a slot in the ferrule. As Young wrote, "...additional firmness is thus imparted to the tool, and the blade is prevented from turning in the handle, as bradawls will often turn, much to the vexation of the operator." In all probability, the one in the shop was made by the blacksmith.

Grindstone

The shop had "1 old grindstone" in the 1820 inventory.

A grindstone is a cylinder of natural sandstone, from about 12 to 40 inches wide and up to 5 inches thick, in the centre of which is an axle of which one end is extended to form a crank. In some a treadle was added so that it could be operated by foot allowing both hands of the user to be free. Some were mounted on a strong wooden stand, and the lower half of the stone was often enclosed in a wooden trough containing water. They are used for grinding the cutting bevels of edged tools, such as chisels, gouges, plane irons, axes.

Woodworking Tools in the Shop¹

Blacksmith shops generally have some woodworking tools.

The shop had "3 Drawing Knives," "6 old paring chisels and gouges," and, "2 Gimblets." A drawing knife, often called draw knife, is a cutting instrument, consisting of a blade with two handles at right angles to it. Salaman describes it as:

The common form consists of a flat or curved blade made in sizes from 8 to 18 inches long and up to about 2½ inches wide. The blade is normally chisel-shaped in section and bevel-ground on its front edge. Tapering tangs at both ends of the blade are bent at right angles to the cutting edge and are fitted with wooden handles, usually turned, with the end of the tang clenched or riveted over.

These tools are used in many different trades for the removal of surplus wood and for rounding and chamfering. In operation, the work may be held between the bench and the user's chest, but more often in a Shaving Horse, Brake, or Vice, and the tool drawn towards the user.

1. These tools will be discussed further under The Carpenter.

The blacksmith would have used the drawn knife for making tool handles and other woodwork. An old handsaw was listed in the 1820 and 1821 inventories.

A paring chisel is the ordinary hand chisel of the woodworker. It is used by the hand only and not struck with a mallet as is the firmer chisel. The chief difference lies in the longer handle of the paring chisel.

A gouge is a chisel with a hollow or semi-cylindrical blade for scooping or cutting holes, channels, or grooves, in wood.

A gimlet is a small, screw pointed tool used for boring holes in wood.

Miscellaneous Items

The 1816 inventory listed "1 pr. Couplets," which are simple strap hinges; "4 Steel Springs," used in beaver traps; "2 Cupboard Lock." The 1820 inventory lists "9 Setts Horse Shoes," clearly indicating the making of horse shoes by the blacksmith. "1 Burnished" iron, is probably a burnishing iron. It is like a file without teeth, handled and is very smooth. It is used to give a bright finish to iron. The "1 Breach iron" is probably a broach. A broach is a steel tool, generally tapering, and of polygonal form, with from four to eight cutting edges for smoothing and enlarging holes in metal; sometimes made smooth or without edges, also called a reamer.

Uninterpreted Items

There are some items which cannot be interpreted as to what they are. They do not appear to be essential; "3 drawing pincers," appears in the 1816 inventory. Drawing pincers are generally used for reducing the thickness of wire by drawing it through a series of large to smaller holes. There would appear to be no need for this at the Fort. No interpretation can be given to "2 pr Trenches for models;" nor the "2 Setts Hollows & Rounds for making augers." The 1816 inventory lists "1 Boulin," French for bolt. This is inventoried along with the set hammers. The 1820 inventory lists "1 Bolt Wedge;" it could be interpreted as a bolt swedge. The 1816 inventory lists "1 Rengale for repg pipes of bellows," which could be the "1 Bellow pipe" mandrel listed in the 1820 inventory.

Additional Items Not Listed in the Inventories

Work benches would be essential to the blacksmith and was not inventoried, being a fixed item of the shop. There would be several tubs, not only for water, but for holding the fuel. A box kept on the forge for holding flux, which at the Fort was probably sand. This was essential in welding. Any work that extended any length beyond the fire of the hearth had to be supported on the other end. This was accomplished with a stock prop, a "T" shaped stand with spread legs, upon which the stock rested. Several farriers tools for shoeing horses should be included.

GLOSSARY

Bending

The blacksmith made bends of every description on most of the work he performed. Cold bending was rarely used except on small items where strength was not necessary. A round bend can be shaped over the horn of the anvil, or, in the case of making rings, on the floor mandril. Square bends are shaped over the edge of the anvil face or in the vice. There are special bending tools, such as a forked-like tool which fits into the hardie of the anvil. A scroll fork, as the name indicates, is for forming scrolls. These can be of different sizes and shapes.

Beveling

This is hammering, while hot, the end or edge of a bar or rod to form a diagonal surface. Useful in welding.

Drawing Down

This is the process of increasing the length of a piece of metal and at the same time reducing its cross section. This is also referred to as fullering. For example, the flat blade of a hoe was drawn out to taper its bottom edge. A fuller is used when drawing out large pieces.¹

Flux

Used in welding. It may be borax or clean sand. See welding.

1. The method of using this tool is described under Fuller.

Hardening and Tempering

Forged tools are not hard enough to hold or take a finely ground cutting edge. They had to be tempered to make them tough enough to be used for cutting. Watson describes the process of hardening and tempering:

Tempering was a two stage process, carried out after the blacksmith had forged and shaped the tool and made a shank on its end to fit into a wooden handle. The finished tool was heated and plunged at once into cold water, making the tool very hard but brittle—so brittle that if the tool was used for work at this point, pieces of iron would chip off.

The second stage was known as "drawing the temper." The heat-treated tool was once more put into the fire and allowed to soak up head slowly until about two inches of the tip was a bright cherry red. Then it was immediately quenched in the slack tub. The tool was still hot—for this quench simply meant sudden cooling to a degree, not until stone cold. The iron now had a distinctive colour, a colour that would change as the iron cooled. The blacksmith now had to watch the colour carefully, so he brightened and cleaned the metal by rubbing it with a piece of old brick. As the iron continued to cool, it showed a band of different colours, moving slowly toward the tip of the tool. The band ranged from light yellow to straw, to brown, to purple, and then, at the tip, to blue. When the colour that the smith wanted for the particular tool reached the tip, he again plunged the iron deep into the slack tub, this time swirling it around to ensure even and complete cooling. Each type of tool required its own temper, as represented by the colour of the iron during tempering. Tempering, then, meant reducing the hardness of a metal to a fixed point: in no case, however, did the smith draw any more temper than was absolutely necessary, since this softened the tool again.

Hardening and tempering were essential and a blacksmith had to know thoroughly the various stages as described above.

Shoulder

This is the lower surface formed by the difference in height of surfaces on a piece of iron; the higher surface is known as the "boss."

Twisting

For decorative purposes, a series of twists are made in iron rods, such as for fences, gates, lattice work. This could be done in two ways, placing the rod in the vice, while heated, and twisting the extended end with a pair of tongs; special twisting bar, of different sizes depending upon the size of the rod, were used. This was a straight rectangular iron bar with one or more square holes in the flattened center. The bar to be twisted was placed in the square hole and, grasping the two handles, the iron was twisted.

Upsetting or Jumping Up

This operation is used to thicken, or bulge, iron. It is the reverse of drawing down. It may consist of thickening a portion only, such as the middle or end, or both ends. The operation is performed by heating the iron to a yellow heat, or what is named a whiteheat, and placing one end upon the anvil or upon the ground, and striking the other with 3 or 4 hammers, as required. This operation was used extensively in making bolts; to first form the head before finishing its shape in a heading tool.

Welding

This is the process of joining, or the fusion of two pieces of metal by heating and hammering. Smith describes it:

...The metal must be kept clean and every effort made to prevent scales from forming, which impair proper welding. When heated, iron and steel form scales. This is brought about by the oxygen in the air attacking the metal, causing oxide of iron to appear. These are small particles of iron that have become oxidized and have a higher melting point than the iron or steel itself.

The melting point of the scales can be reduced by the use of fluxes.

...The flux helps prevent the oxidation of the metal;...

Fluxes, such as borax., and clean sand, are put sparingly on the metal just before the welding heat is reached. The flux lowers the melting point of the scale, allowing the scale to run off, and at the same time serves as a prophylactic, sealing out the air which would cause more oxide of iron to form. After the flux is applied, the metal is brought to a welding heat and welded on the anvil with the hammer.

There are several methods of welding or forming the joints. Bealer describes the basic ones:

"Lap welding" is nothing more than lapping the scarfed end of one bar over the scarfed end of another to join them together at welding heat...

"Butt welding" is welding the ends of rods or bars together butt to butt, instead of scarfing them for a lap weld. Also a rod may be butt-welded perpendicularly to a flat bar. This is called a "jump weld." Generally a butt weld is undependable; most smiths prefer to lap welds. The "T-weld" is to join the end of one flat bar perpendicularly to another flat bar at a point away from its end.

A "tongue weld" is accomplished by splitting one piece of iron and tapering the piece to which it is to be joined, then inserting the taper into the split before welding.

Taking a Heat

It is very important that the smith should know the signs and the effect of burning iron and he should be able to recognize instantly the correct degree of temperature which he requires for a particular operation. Moxon describes the various heats:

Of the several Heats Smiths take of their Iron. There are several degrees of Heats Smiths take of their Iron, each according to the purpose of their work. At first, a Blood-red Heat. Secondly, a White Flame Heat. Thirdly, a Sparkling, or Welding Heat.

The Blood-red Heat is used when Iron hath already its form and size, as sometimes square Bars, and Iron Plates, &c. have, but may want a little Hammering to smooth it...

The Flame, or White Heat, is used when your Iron hath not its Form or Size, but must be forged into both;... A Sparkling, or Welding-heat, is only used when you double up your Iron (as Smiths call it) to make it thick enough for your purpose, and so weld, or work in the doubling into one another, and make it become one entire lump; or it is used when you join several Bars of Iron together to make them thick enough for your purpose, and work them into one Bar; or else it is used when you are to join, or weld two pieces of Iron together end to end, to make them long enough;...

The blacksmith flourished as a major social force in the modern world for more than two thousand years. During forty generations of hand labor there had been scarcely a single significant change in his tools and anvil techniques, or in the smelting, forging, and treatment of iron. Then - nearly within the span of one lifetime - the vital role of the blacksmith vanished. (Watson)

This is not considered an exhaustive glossary; the terms described are basic to blacksmithing.

APPENDIX IV

SAFETY CONSIDERATIONS
BLACKSMITH SHOP

The Blacksmith Shop at Fort Vancouver National Historic Site is a reconstruction of an authentic, working blacksmith shop based on the original shop at Fort Vancouver. The shop will be operated as a living history interpretive program. Authenticity of materials, methods, and products will be maintained as much as practically can be expected. The safety of the employees, the public, and the resource will also be considered. The following policies will be instituted to meet these safety goals:

1. Two fire extinguishers will be located inside the shop; one within reach of the blacksmith's work area, the other near an exit where another employee can get it upon entering the structure. A fire alarm system is installed in the building and a water source is also available inside.

2. Materials and equipment will be stored in an orderly fashion and out of the way of workers and visitors.

3. Tools and the forges in use will be inspected regularly for wear or damage, and will be replaced or repaired before further use.

4. Ropes will be used to keep visitors away from the work area. The building will be closed up and locked when an employee is not present.

5. A skilled blacksmith must be present during the operation of the forge.

6. Proper clothing will be worn by demonstrators. Natural fibre clothing will be used for authenticity as well as for their qualities of being less flammable than synthetics. Long shirt sleeves will be worn to protect the blacksmith's arms from burns.

7. The forge will be cleaned twice each week or as needed (depending on use). The bellows should not be left in such a way that the leather portion is taut or crumpled when not in use. The leather will be treated periodically with Lexol or some other product to keep it from becoming brittle.

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