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FILE NO.

Historical Documentary Report on the
BRIDGE AND WHEEL HOUSES,
Hopewell Furnace

(Buildings 10 and 8, Hopewell Village National Historic Site)

By
Russell A. Apple
Park Historian

September 28, 1956

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Explanations:

BRIDGE HOUSE (Building 10): Since charges of iron ore, limestone and charcoal were introduced into the top of a furnace stack approximately 30 feet high, a means was necessary to hoist and deliver these raw materials to the top. Hopewell Furnace utilized a typical solution to the problem of delivering charges to the tunnel-head, or top of the furnace. The furnace was built close to the base of a small hill, called the furnace bank. A bridge and/or ramp crossed from the hill to the top of the furnace. Over this ramp-bridge combination the raw materials were carted by hand. The portion of the bridge-ramp combination closest to the furnace was enclosed by sides and roof and called a Bridge House. Other portions of the bridge-ramp combination were covered, at least in later years, by a roof, but the sides were open. The portion covered by only a roof is called, for the purposes of this report, the Portico.

¹ Measured Drawing, Hopewell Furnace, RDP-PA-FC-SP7, Nov. 30, 1936.

² Walter E. Hugins, Early Nineteenth Century Iron Furnaces, A Comparative Study, Jan. 7, 1954, pp. 4,5, and illus.; Frederick Overman, The Manufacture of Iron, In All Its Various Branches, London, 1954, pp. 149, 171; Charles S. Boyer, Early Forges & Furnaces in New Jersey, Phila., 1931, p. 6; Arthur C. Bining, Ph.D., Pennsylvania Iron Manufacture in the Eighteenth Century, Harrisburg, 1938, p. 33. A picture of Hopewell's Bridge House is on p. 50.

³ Hopewell Furnace Journal, 1800-1802, p. 310 (At Historical Society of Pennsylvania); SM 31, Apr. 7, 1847. (See Apple, Documentation for the Historical Base Maps, June 5, 1956, pp. 4-5, for explanation of numbering Hopewell Manuscripts); SM 34, p. 266.

⁴ Harker E. Long, verbatim notes taken by Roy E. Appleman, Dec. 1935; Roy E. Appleman, Proposed Restoration Plan for Old Iron Making Village.

WHEEL HOUSE (Building 8): A blast of cold air was supplied to Hopewell Furnace by machinery located, at least in later years, immediately to one side of the Bridge House. This blast machinery, with the water wheel which powers it, was restored by the National Park Service in 1952.⁵ This blast machinery, and the water wheel immediately under it, was protected by the Wheel House, which was probably enclosed on three sides and protected by the Bridge House on the fourth side.⁶ The Wheel House roof covered the machinery.

Stockpiles of the raw materials used to charge Hopewell Furnace were made on the furnace bank. Iron ore and limestone were kept in piles made in the open.⁷ But charcoal, which deteriorates if stored in the open, was either piled in a large stone building, called a Charcoal House (Building 9),⁸ or else dumped in the Portico.⁹

Measured drawings of the types of charcoal and ore carts believed used at Hopewell are numbered 5-1 in the plan file at Hopewell Village. Examples of such carts may be found at Cornwall

French Creek Project, Hopewell, Penna., Jan. 15, 1936, p. 34 and illus. in portfolio; Nathan Care, Jr. and Mr. and Mrs. (Violet) Care, interview by Howard Gale, Jan. 15, 1941. Other interviewees describe the Portico.

5

James Cass and Walter E. Hugins, Completion Report on the Restoration of the Water Wheel, Blast Machinery, and West Head Race, Aug. 1, 1952.

6

Long, verbatim notes by Appleman, 1935, op.cit.; Appleman, Restoration Plan 1936, pp. 35-36.

7

Long, verbatim notes by Appleman, 1935; Appleman, Restoration Plan 1936; Hunter Care, interview by Voorhis, June 24, 1939; Long, Comments on notes made during interview of Aug. 7, 1936.

8

Oberman, Manufacture of Iron (1854), op. cit., pp. 171-172; Bining, Pennsylvania Iron Manufacture, op. cit., p. 76

9

Long, verbatim notes by Appleman, 1935.

Furnace, Pennsylvania, administered by the Pennsylvania Historical and Museum Commission.

A History of the Bridge House:

Hopewell Furnace was constructed by Mark Bird in 1770-¹⁰ 1771. Since a means was needed immediately to hoist and deliver charges to the tunnelhead, we believe that at least a bridge had been constructed by 1771, the first year Hopewell Furnace may have been in blast. Blast and documentary data on the years preceding 1800 have not been located. However, the juxtaposition of the tunnelhead and furnace bank are such that it would seem unwise to assume that any means other than a bridge and/or ramp was utilized to deliver charges. The first mention of a bridge house in the known Hopewell Manuscripts¹¹ was made in 1801. A conjectural restoration of the first bridge-ramp combination is included in a cross section drawing of the conjectural¹² restoration of the early blast machinery believed used at Hopewell. A plan of the masonry walls in the area between the Charcoal House and Hopewell Furnace is attached for reference purposes, since hereafter in this report walls will be identified by letter. It is believed that the first wooden bridge was supported on Walls A and I, and that the solid ramp portion was only that area between the Charcoal

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Russell A. Apple, Documentation for the Historical Base Maps, June 5, 1956, pp. II-112, II-113.

¹¹

Day Book, 1800-1802, p. 310 (At Historical Society of Penna.)

¹²

See Drawing No. NMS-HQVI-3060, Conjectural Restoration of Early Blast Machinery, Hopewell Furnace, sheet 2, Aug. 16, 1956.

4

House and Wall I. Wall B may indicate an inter-terminus for the wooden bridge. Certainly part of the bridge-ramp combination was covered, since the 1801 entry speaks of a Bridge House.

It is believed that the height of Hopewell Furnace until 1828 was several feet lower than its present height. Since one end of the bridge floor connected with the top of the furnace, an increase in the height of the furnace would necessitate physical changes in the bridge.

On March 16, 1828, Hopewell Furnace went out of blast for 390 days. It started operations again on May 10, 1829. In 1828, 528-1/4 man-days of work were credited to the "Furnace Stack," including much masonry. It is believed that the work accomplished included adding several feet to the furnace. In 1829, there were 694 man-days of carpentry on projects of an unspecified nature at Hopewell Village, as well as 127 and 3/4 man-days of masonry on unspecified projects. If the furnace stack were raised several feet in 1828, it probably would have been necessary to remove the wooden bridge in order to accomplish the masonry, and necessary to rebuild the bridge again before the furnace returned to blast. It is probable that the

13

Apple, Documentation for HSM, op.cit., p. II-115.

14

SM 13, p. 86.

15

SM 14, pp. 36-37.

16

Long, interview by Kemper, Aug. 7, 1936.

17

See Chart, Days of Carpentry & Masonry on Unspecified Projects, 1801-1833, Hopewell Furnace, in Appendix of Apple, Documentation.

masonry and carpentry on unspecified projects in 1829 included the rebuilding of the bridge. The furnace returned to blast in May 1829, and this late a start in the year would permit time to rebuild during fair spring weather. The second bridge and/or ramp would have had a different floor grade if its terminus was higher than previously. It may have been possible by 1829 to have shortened the wooden bridge and utilize a longer solid ramp, due to an increase in the length of the furnace bank. The possible shortening of the wooden bridge portion, and the increase in the grade, would indicate that perhaps the entire bridge-ramp combination was revised in 1829. We would guess that the wooden bridge now ended at a point between Walls A and H.

We believe that the first Bridge House (1771-1828) was narrower by approximately five feet than later Bridge Houses. This is based on an interpretation of the masonry wall remains of the first water wheel pit and its associated walls. This first water wheel pit ran parallel to the centerline of the ramp-bridge combination and was in use until circa 1800.

It should be noted that the outside lines of the side walls of the large door on the southern side of the Charcoal House, if extended, would join on the outside lines of the east and west faces of the base of Hopewell Furnace. (See plan of walls, attached). The bridge-ramp combination ran between this southern door, in a straight line, to the tunnelhead.

18

James Cass, Memo. to Reg. Dir., Reg. One, Conference, June 6-7, 1950 (Attended by Appleman, Higgins, Denniston, Weig, Kurjack, Cass), June 7, 1950, p. 2.

The wall (termed Wall A) which evidently was the first support north of the furnace was bonded to and ended at a wall (termed Wall C, which is actually a part of Wall A) which, in turn, was bonded to and probably was a part of the east wall of the first wheel pit. The bonded condition indicates that they were built at the same time. The Bridge House about which we have some detailed knowledge (termed in this report the 1847 Bridge House), extended widthwise into the space over the first wheel pit. The position of the main east-west portion of Wall A in relation to the furnace would place the center of any bridge it supported to the east of the center of the furnace, and approximately five feet of the broad masonry base of the furnace on the west side would not have been covered by the bridge. On this west side of the Bridge House, and parallel to it, was the first wheel pit. It seems obvious that this five feet of space was left open to accommodate the water wheel which existed in the first wheel pit. While the first water wheel would not have occupied this space, room may have been needed to work on the east side of the wheel. There was approximately seven feet of space between the western end of Wall A and the water wheel which we have conjecturally restored in the drawing, and this space may have been needed to work on and adjust the gates and forebay which controlled the flow of water to the wheel.

19

Paul J. F. Schumacher, Archeological Explorations at the Furnace Group, 1935-1951, Sept. 1951, pp. 25-26.

20

See Drawing No. NHS-NOVI-2060, Conjectural Restoration of Early Blast Machinery, Aug. 16, 1956.

We believe that the first (1771-1828) Bridge House was as wide as the main east-west portion of Wall A, and therefore not centered, at least on its non-furnace end, on the furnace, because this Bridge House and Wall A would have been built to fit in with the first water wheel and blast machinery arrangement.

About 1805, during the life of the first Bridge House, the first wheel pit and wheel were abandoned and a new wheel pit and wheel were built whose long axes were approximately perpendicular to the center line of the bridge-ramp combination.²¹ This placed the new wheel, and any blast machinery above it, farther away from the first Bridge House. Probably at the same time as the second (east-west) wheel was installed, the method of providing blast also changed from bellows to crude casks, and later the cask arrangement was modified to the tub method, similar to the existing restored blast machinery.²²

In 1829, with the east-west wheel more removed from the Bridge House area, it would have been possible to have widened the bridge to make it as wide as the base of the furnace, and cover part of the first wheel pit.

Wall H, which separates the village into two prominent levels, was found on September 21, 1956, to be bonded to Wall D, a condition previously unknown.²³ This bonding occurs at the back, upper, or north

21

Apple, Documentation for HBM, pp. II-85, II-86.

22

Apple, Documentation for the HBM, pp. II-119, II-120.

23

Schumacher, Archeological Explorations, op. cit., p. 38.

side of Wall H. Wall H consists, at least at the line of contact with Wall D, of two walls, a northern wall with a vertical southern face, and a veneer added to the southern face. The veneer has a batter. It is this batter veneer which is not bonded to Wall D, and was until recently the only point of contact between Walls D and H which could be inspected. We shall call the north, original, and vertical faced part of this wall Wall H Original. From the bonding it is evident that Wall D and Wall H Original were built at the same time. Since the southern end of Wall D is not bonded to Wall A, we surmise that Wall D was built later than Wall A. The eastern side of the space north of Wall A was probably left open to install and maintain the counterweights of the early blast machinery. The western side of this space was blocked by Wall C. With the abandonment of the early blast machinery, there was no longer any reason for access to this space.

Apparently, in 1829 it was possible to make the Bridge House as wide as the base of the furnace. The furnace bank may by that time, due to the accumulation of charcoal dust, have extended as far south as the line now represented by Wall H. We believe that Wall H Original, Wall D and Wall O were built in 1829 (or 1828 since wall building must occur before the erection of the structure it supports). Walls D and O, both approximately north-south walls, had their outside faces at their southern ends on the lines extending from the masonry walls of the southern door of the Charcoal House to the broad base of the furnace. Wall O was built over a part of the first wheel pit.

The northern ends of Walls D and O were not parallel, but began to come together. In plan, they were not straight walls, but each had a point about half way where the walls pinched in to lessen the distance between them. A 1938 plan shows Wall O with the northern half moved eastward, but this plan shows Wall D as a straight wall. Drawings made in 1951 of Wall D indicate that its northern end moved westward, and physical examination of the lowest courses of Wall D in 1956 confirm this. It is probable that Walls D and O were reverse images of each other. If this is the case Walls O and D were probably built at the same time, and this would make Walls H Original, D and O contemporary. We would date them at 1828-29. The veneer face of Wall H may have been added at any time later.

Since the top courses of Walls C, D and O were missing by 1938, we do not know if they contained steps or gaps to admit timbers. We considered the possibility that just Walls D and H Original were built in 1829, with the then existing Wall C performing Wall O's function, but since Wall C did not extend as far north as Wall D, and probably was not as high as Wall A, this possibility was dismissed. We believe that the function of Walls D and O, at least after 1847, was to retain the sides of the solid ramp. Retaining walls usually are straight. But Walls D and O begin to pinch in and change direction towards one another. We believe that this pinching-in point marks the division line, in 1829, between the wooden bridge and solid ramp. Wall A, in 1829, probably supported part of the wooden bridge.

Since Wall A did not fill completely the space between Walls D and O at their southern ends, Wall A was extended westward to meet Wall O. The details of this extension are shown on a 1938 drawing.²⁴

The wooden bridge part of the 1829 Bridge House probably extended from the tunnelhead to the point on Walls D and O where they begin to move together. The solid ramp began at this point, narrowed slightly and then extended to the wide southern door of the Charcoal House. Probably the portion of the bridge-ramp nearest the furnace was enclosed.

We believe that by the end of 1847 another Bridge House had been constructed, or at least major structural changes or additions were made to the 1829 building. In 1847, 53 and 3/4 man-days of carpentry were expended on the Bridge House.²⁵ Also in that year, 50-1/2 man-days of carpentry were expended on projects of an unspecified nature, which projects could have included work on the Bridge House. There were only 4 man-days of masonry on unspecified projects in 1847, and none in 1846,²⁶ so there could not have been much wall building in connection with the 1847 Bridge House carpentry. The walls which we believe then existing, Walls A, D and O, were probably utilized. However, by 1847, the charcoal dust on the furnace bank had accumulated so that the wooden bridge portion now extended only

24

Drawing No. RDP-PA-FREN 9273-1-1, Christian Eben, Aug. 2, 1938.

25

SM 32, p. 35.

26

Chart, Days of Carpentry and Masonry, op. cit.

as far as Wall A, and Wall A became a major retaining wall for the furnace bank. The windows in Wall A, which had previously been connected with the counterweights, could now be blocked up to make a solid wall. Walls D and O, parts of which had previously served to support the wooden bridge, now became retaining walls for the solid ramp. After 1847, we believe that Walls A, D and O, with Wall A forming the bottom, were a "U" shaped arrangement for retaining the solid ramp. Between 1829 and 1847 this same "U" shaped area had been only partially full of solid material, and the part not full had been covered by a wooden bridge.

There seems to have been time to rebuild the Bridge House in 1847. Hopewell Furnace went out of blast on February 14, 1847,²⁷ and remained out of blast until May 2, 1847, a period of 76 days. The return to blast in May seems to indicate a later than usual start.²⁸

We believe that in 1847 the Bridge House was constructed in its last form, the form remembered by the interviewees. We have several photographs (attached) of Hopewell's Bridge House taken after the furnace ceased operation (1883) and it is believed that these are of the 1847 Bridge House.

Weighing Ore Charges

The practice of weighing furnace charges of iron ore seems

27

Chart, Physical History of Hopewell Furnace, prepared by Dennis C. Kurjack, n.d.

28

Ibid.

to have begun in the 1840's, although it was still not a general practice by 1854. One authority declared in 1854 that

The filling of ore by the measure should be repudiated altogether. If this method is tolerated in the case of coal [charcoal or anthracite], it will not answer with ore, for ore is of great specific gravity and an imperceptibly small quantity may amount to more than the necessary regularity of furnace operations will permit.²⁹

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Hopewell bought scales specifically for the Bridge House in 1847.

Perhaps these are the same scales which were donated to the Historical Society of Berks County, Reading, Pennsylvania, by Nathan Care, Jr., about 1939. The scales cost Hopewell \$35.00, and the cost of carpentry to install them cost \$1.50, and this work is not included in the totals for either the Bridge House carpentry or in the unspecified carpentry for 1847.

We do not believe that furnace charges at Hopewell were weighed prior to 1847. The adoption of the weighing practice at Hopewell may have caused some structural changes in the 1829 Bridge House, and caused the erection of the Portico.

When Hopewell bought scales for the Bridge House, it is thought that Hopewell's technology changed. We believe that prior to 1847 that the ore charges had been determined by measure, with the judgment of the filler (man who placed the charges in the tunnelhead).

 29

Overman, Manufacture of Iron, p. 196.

30

SM 31, Apr. 7, 1847.

or of the ironmaster, the determining factor. A rule-of-the-thumb probably governed the size of the ore charges prior to 1847, and the man who determined the size was highly skilled and experienced. It is said that ironmaster Clement Brooke (ironmaster ca. 1800-1847) spent much of his time at the tunnelhead.

With the adoption of weighing, a more standardized operation probably began. Less attention could be paid to tunnelhead operations, and perhaps the presence of a highly skilled filler would not always be required. Small variations in the amount of ore could be made at the direction of the keeper, the man who ran out the iron. Also significant is the fact that with standardized charges, the charges could now be prepared in advance, ready for deposit in the tunnelhead.

The year 1847 was the last year ironmaster Clement Brooke was in personal supervision of the furnace. ³¹ Perhaps he spent his last year making all the changes necessary to switch from measuring to weighing, and in determining the weight of charges and other operational factors. This may have been done in preparation for manager-ship of his son-in-law, Dr. Charles M. Clingan, who took over in 1849. Another relative, John Church, managed the furnace for the intervening ³² year, 1848.

With charges approximately standardized, charges could be prepared in advance. The charges could be stored, ready in carts.

31

SM 32, pp. 19, 436.

32

SM 32, pp. 64, 846.

The scales, where charges were prepared, were located in the Bridge House, on the east side adjacent to the tunnelhead. The ore stock-pile was kept on the furnace bank. Any excess ore after the charge was weighed would best be deposited near the scales. Such a deposit of ore would form a supply of ore near the scales which could be used to add to any charge found light upon weighing. The Bridge House had bins for this purpose (see below). In the Bridge House then, would be a small supply of ore held in bins.

Before 1847 and weighing, there was also a supply of ore in the Bridge House. In 1801, Edward Hughes was paid for "7-1/2 months of him filling Furnace and his setting ore and piling it in Bridge House." We do not know how much ore Edward Hughes could pile (note the word pile) in the first Bridge House (1771-1828). In 1803, we get a more detailed description of Hughes' job, when he was re-hired. "Edward Hughs [sic] Agress to Do the Work he Formaly don at the Furnace that is Do the Work of ore Filler and Put in half of the Night Stock to Set and Prepare the Mine [ore] Ready for Pulling into the Furnace The mine to be Put in the Bridge haus."

33

Nathan Care, Jr., interview by Motz, Feb. 13, 1941; Lafayette Houck, interview by Voorhis, June 24, 1939. Long placed them in the Bridge House but did not locate them as to actual position. They were called platform scales by some interviewees, but others said that they were not true platform scales, but that their weighing surface was flush with the floor and a cart could be pushed onto them.

34

Day Book, 1800-1802, p. 310 (At Historical Society of Penna.).

35

SM 1, p. 27.

Edward Hughes, in his capacity as filler, may have added ore to the furnace by rule-of-the-thumb, as needed, and have required a small stockpile of ore near the tunnelhead upon which to draw. He evidently aided the night filler by depositing half the amount of ore usually used during the night shift. After ore was weighed, and not deposited by bulk, the position requirements for filler may have changed from highly specialized to less specialized. After weighing was adopted, the filler's job may have been merely to dump a pre-weighed charge in the tunnelhead opening at specified times. Perhaps he varied slightly the weight of the ore charge, or time between charges, as directed. Under these conditions, it would be possible to have a supply of pre-weighed ore charges standing by, probably in carts. Limestone was added by the shovelfuls, and probably one bin would hold enough for a shift. Charcoal, however, formed a considerable part of the charge, and would also be stored in carts. Charcoal was apparently never weighed at Hopewell, but was deposited by bulk measure. A pre-weighed and predetermined charge would consist of probably two ore carts, two or more charcoal carts, and 3 or 4 shovelfuls of limestone. Of these raw materials, charcoal required the most protected storage. A large Charcoal House was provided for the storage of charcoal awaiting use in the furnace. But iron ore and limestone were stored in open piles. Pre-pared charcoal charges would require the same protected storage as was available in the Charcoal House.

It is believed that the bulk of the space in the 1847 Bridge House was taken up by carts full of charcoal. The 1847 Bridge House was completely enclosed by roof and siding, and the southern open end was protected by the Portico.

That the practice of having the "Night Stock" at least partially stored in the Bridge House was continued after weighing was adopted is attested to by an authority who said in 1854 that, "But, under all circumstances, there should be a bridge house, sufficiently large to receive the night stock, and where possible, also the Sunday's stock." ³⁷ The Sunday reference was probably a concession to religion, but at Hopewell there may have been a practical advantage of storing the night charges near the tunnelhead. The night crew contained, at least after 1867, only two men; while the day crew had three men. Although the third man on the day crew had the responsibility of removing all the slag deposited in a 24 hour period, ³⁸ any additional duties he may have had (such as helping prepare casting beds, or aid in the tap of iron) may have been assumed during the night shift by the night filler. If the charges for the night filler were ready in carts, his time would not be spent in transporting iron ore and charcoal from the furnace bank to the tunnelhead, and/or in weighing the ore. The night filler would be available to aid the other man on his shift as needed.

37

Overman, Manufacture of Iron, 1854), p. 171.

38

Marker A. Long, A Short History of the Hopewell Furnace Estate in Union Township, Berks County, Reading, n.d., (1930), p. 19.

If charges were not made up in advance and stored in carts, there would be need for few ore and charcoal carts. Yet as late as 1936, there were approximately 20 ore and charcoal "buggies" on the furnace bank. ³⁹ A surprising number of ore and charcoal carts are preserved at Cornwall Furnace.

In 1849, Philip Naugle was paid \$288.00 for "putting ore in ⁴⁰ Bridgehouse for the Furnace from May 20th/48 till May 20th/49." Naugle didn't pile, he put ore, a change in word choice which may indicate the change from a loose pile of ore to pre-weighed ore in carts. Naugle's job may have been the pre-weighing of ore charges. This task may have been later assumed by the day filler, at least after 1867, Long's first year at Hopewell.

If the enclosed Bridge House was reserved for carts full of charcoal, then the portion of the Portico nearest to the Bridge House may have been reserved for carts full of ore. It should be remembered that for discussion purposes we separate the Bridge House from the Portico, but Long and others spoke of the Bridge House as extending from the Charcoal House to the tunnelhead. The interviewees apparently had no separate term for the Portico. To them, it was the Bridgehouse. Carts full of ore may have lined one or both sides of

39

Mrs. Daniel (Violet) Care, interview by Gale, Feb. 13, 1941; Jacob Glass, interview by unknown, Jan. 3, 1941. Glass said that Nathan Care, Jr., (last farm manager) threw the carts over the steep furnace bank to destroy them following a series of arguments with the administrators of the French Creek Project.

40

SM 32, p. 68.

the approach ramp from Wall A to Wall H after 1847. Such placement of carts would still leave room between the carts for work space.

One reason for the Portico existed in 1771. This would be for a covered passageway from the Charcoal House to the tunnelhead to protect charcoal in transit. A second reason occurred after 1847. This would be for dry storage of iron ore. A wet charge of iron ore would weigh more than a dry one. Perhaps in rainy weather iron ore was first dried under the Portico before it was weighed, and in any weather weighed charges would be under cover. The steam emanating from a wet charge introduced into the furnace may have been eliminated after 1847.

The change in technology which came with the adoption of weighing at Hopewell in 1847 seemed to require a Bridge House which could contain bins for ore found excess after weighing and for the dry storage of charcoal in carts; for a Portico for the storage of pre-weighed ore charges in carts and which could be used for drying wet iron ore, and for keeping dry loads of charcoal dumped under it. The technological change also apparently permitted a five man furnace crew, such as Long was familiar with after 1867. For the purposes of this report we assume that the Bridge House to be rebuilt by the National Park Service was constructed in 1847.

The 1887 Bridge House:

The attached photographs of the 1887 Bridge House offer some detailed information on exterior appearance. Some were taken after deterioration had progressed sufficiently to reveal interior framing. The date, if known, is marked on each photograph. Each photograph is further identified by its negative number.

Let us take the 1896 Fall Photograph 101-07 and identify the parts of the Bridge House visible. At the left and forming a small triangle up into the sky is a brick firewall.^{h1} Through an arched opening in this firewall the charges were dumped into the tunnelhead. This firewall protected the wooden Bridge House and shielded the filler. Between the Firewall and the Bridge House is a covered space. This has been termed a vestibule and protected the space between the Bridge House and the firewall.^{h2} Next comes the Bridge House. Its left, or southern end, is supported by a step in the furnace. Its right, or northern end, is supported on Wall A.^{h3} When this picture was taken, the near or east side of the Bridge House was supported on Walls E, F1 (with window) and F2 (hidden). Its far or west side was supported by a truss which extended from the furnace to Walls E and A, there being no walls on the west side. The informant on this point was

^{h1}

The 1920 Postcard 35-25 gives more detail and shows the arched opening. The 1920 Stauffer 125-09 shows the brick detail.

^{h2}

Charles Sheridan Painter, interview by Higgins, Apr. 15, 1953.

^{h3}

See 1920 Stauffer 125-09.

born at Hopewell Village, and during his early adult life did construction and repair work at Hopewell. He is now a contractor. The informant doubted that the truss was original, and thought that a long timber was first used.

The roof of the Portico may be seen between the Bridge House and the tree which unfortunately hides the supporting posts. The roof on the far right is the southward projection of the Charcoal House, which contains a door. A small portion of the Portico roof may be seen where it attaches to the southward projection. The wall showing under the Charcoal House roof is a portion of Wall H, and the large dark area at the extreme right edge of the photograph is the Ore Roaster (Building 3h). A better view of the roaster and Wall H may be seen in the 1937 Stokes photograph 125-01. This 1936 Wall photograph 101-07 was chosen because it shows portions of all the elements of the area between the Charcoal House and the tunnelhead. Other photographs show other details of specific features.

The grade up which the loaded carts were pushed started at a point on the furnace bank and ended on a level with, but a few feet north of the tunnelhead. No known photograph shows this grade. The part of the grade immediately in front of, or north of, the tunnelhead was approximately level and contained the scales.

11

Charles Sheridan Painter, interview by Eugins, Apr. 15, 1953.

15

Lafayette Houck, interview by Voorhis, June 21, 1939;
Nathan Care, interview by Motz, Feb. 13, 1941.

The scales have been placed on the east side of this level area,
 and this level area was apparently covered by iron plates.¹⁶ One of
 the informants said that this level space extended six feet north
 of the tunnelhead, but in making a profile of the grade we have
 allowed eight feet.¹⁷

Two of the photographs (numbers 17-10 and 35-26), taken
circa 1926, show the bridge house in a dilapidated condition. One
 photograph shows the east side and the other the west side.

Vertical siding missing from both sides permits the identification
 of two huge framing members, one on each side, which probably
 supported the bridge house floor, which would be a part of the
 grade. Using the edge of siding as a true vertical line, or a
 plumb, the grade of each floor framing member was approximately
 0.3 per cent.

A wall not directly connected with the bridge house
 should be reintroduced at this point. This is wall A, which ex-
 tended from the furnace bank to the Furnace Office-Store
 (Building 3). This wall separated the village into two prominent
 levels. It was in reality a man-made eastern extension of the
 furnace bank. In 1932, the upper courses of this wall were re-
 moved to permit the construction of a blacktop road which crossed
 over the wall. During archaeological excavations in the summer of
 1955 the lower courses of this wall were found intact. In 1956,

¹⁶

Ibid.; Nathan Care, Jr., interview by Gale, Jan. 15, 1961.

¹⁷

Drawing, unnumbered, Profile of Ramp from Center of Charcoal
 House to Top of Furnace Stack, R.F. Donchoc, July 25, 1956.

the 1887 Stokes photograph was found. The Stokes photograph showed a large part of Wall B as it was in 1887. It was possible to identify and locate in the remaining parts of Wall B individual stones, by the use of scaling, it was possible to reconstruct Wall B in the summer of 1956. The top of Wall B rose from east to west at a continuous slope to intersect with a wall (Wall D) which supported the east side of the approach ramp to the Bridge house. The upper courses of Wall D have been missing for many years and are not known.

If the reconstructed slope of Wall B is extended westward and upward to the point of intersection with Wall D, we assume at this point the tops of Walls B and D coincided. We have therefore located one point on the top of Wall D, which would also be a point approximately on the grade from the furnace bank to the tunnelhead. This point is on the northernmost part of Wall D. If we extend a line from this point on Wall D to a point on a level with the tunnelhead, we arrive at a grade of approximately 9.11 per cent. This is a close approximation of the previously mentioned 8.3 per cent grade. However it is probable that the ramp (of charcoal dust) was rounded, and higher in the center than at its edges. It was the edges of the ramp which were retained by Wall B on the east, and Wall D on the west. If the ramp's center

¹⁸ Drawing, unnumbered, Profile of Ramp from Center of Charcoal House to Top of Furnace Stack, R.L. Donohoe, July 25, 1956.

¹⁹ Survey Report for Restoration and Rehabilitation of Historic Structures for Stone Footings or Wall for Bridge House and its approach ramp, July 12, 1956.

was higher at the point of intersection of Walls H and I than Wall D, then the ramp extended farther out than the intersection and the grade was less.

If we take a point at existing ground level in the Charcoal House, and extend a grade from this point to the point level with the tunnelhead, we arrive at a grade of approximately 7.1 per cent.⁵⁰ If we take the 7.1 per cent grade as the minimum possible for the ramp, and the 8.11 per cent as the maximum possible, we believe that the historic grade lay somewhere between. Perhaps it was the 8.3 per cent as indicated by the exposed framing in the photographs.⁵¹

The 1847 Bridge House was evidently slightly narrower at the Furnace end than at the non-furnace end. The Furnace end was supported on, and we believe as wide as, the second step down from the top. The non-furnace, or north end, was as wide as the broad-out (lower) portion of the north face of the Furnace, if this end were as wide as the outer limits of the walls which retained the approach ramp. The outer limits of Walls E and G, if projected, coincide with the east and west faces of the broadest parts of the Furnace. Since it was found necessary in 1938 to obliterate at least part of Wall D and the westward extension of Wall A, no

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Drawing, unnumbered, Profile, op. cit.

51

See Apple, memo. to Supt., Grade of Bridge House Floor and Approach Ramp; Height of Supporting and Retaining Walls, July 25, 1950.

Further information is available on this detail. This area had been completely destroyed by the time later archeological explorations were made in this area.

Any siding on the west side of the bridge house was probably removed in 1879, when the wheel house roof was joined to the bridge house roof. The interiors of the two buildings became one at that time, although there was a physical separation between the floor of the bridge house and the platform on which the blast machinery stood.

The photographs show only the exterior of the bridge house, and reveal little or nothing about its interior arrangement. We know that the floor sloped upward from north to south, and it is believed that the flooring also ran north and south to permit the easy movement of carts. ⁵² Bins were located against the walls. The informants speak of ore bins on the east side, and one informant of a limestone bin on the west side. ⁵³ In 1915, some ore and charcoal carts were stored in the bridge house on a section of flooring which extended westward almost as far as the platform on which the blast machinery stood, but this section of flooring was at a higher level than the blast platform. ⁵⁴ This parking space would not permit the existence of many bins on the west side.

⁵² Charles Sheridan Painter, interview by Rugins, Apr. 15, 1953.

⁵³ Hunter Carr, interview by Burjack, Mar. 14, 1915; Charles Sheridan Painter, interview by Rugins, Apr. 15, 1953.

⁵⁴ Charles Sheridan Painter, op. cit.

The sides of the Bridge House were said to have been of 1 inch by 1 foot white pine boards, with $\frac{1}{2}$ inch by 3 inch battens nailed over the joints. ⁵⁵ White pine boards were frequently bought by Dogwell. ⁵⁶ The roof was of slate.

Photographs 102-5, the 1920 Smith 22-6, and the 1920 Stauffer 125-09 show the solid ramp approach to the wooden Bridge House floor. The lower courses of wall B show in the Stauffer photograph. The upper courses were missing circa 1915, but are remembered. ⁵⁷ The ramp was composed chiefly, it is believed, of packed charcoal dust.

The 1920 Stauffer photograph 125-09 indicates where the roof of the Portico attached to the north end of the Bridge House. It is believed that the north end of the Bridge House was not boarded up when the Portico existed.

Better information on the Portico comes from the informants and from archeological reports than can be gotten from the photographs. Many of the interviewees remembered and mentioned the Portico (although they did not so term it). The three

55

Ibid.

56

Mr. and Mrs. Morris Lyman Care, interview by Gale, Feb. 6, 1941;
 Mr. and Mrs. Samuel March, interview by Gale, Jan. 22, 1941
 (Mrs. March used slate pieces for writing); Mr. and Mrs. Charles
 Sheridan Care, interview by Gale, Feb. 24, 1941.

57

Charles Sheridan Painter, interview by Eugins, Apr. 15, 1933.

spaces between the supporting posts closest to the Charcoal House were used as driveways, and two loads of charcoal was dumped in each driveway for immediate use in the furnace. The locations of seven post holes (each post was set on a stone) are recorded on original drawings of the archeological exploration in the Portico area, and photographs which show the locations of the known holes are on file at Hopewell. It is believed that at least two additional posts were based on Walls D and O, and that the part of the furnace bank which held another post has eroded away.

The northern end of the Portico roof joined with the southern extension of the Charcoal House. According to the photographs the roof of the Portico was composed of boards. There was no board floor, just earth and charcoal dust surface, under the portico. The Portico covered the solid ramp from the Charcoal House to the Bridge House.

58

Long, interview by Appleman, op.cit.; Lafayette Houck (a collier), interview by Voorhis, June 24, 1939.

59

Original Drawing, Excavation of the Charcoal Fill Between the Bridge House and Charcoal House, 1950, Operation One, J. L. Cotter.

60

See Negatives 106-37, 106-38, 106-39, filed at Hopewell under Bridge House (Building 10), Archeology.

A History of the Wheel House:

According to the Hopewell manuscripts, Michael Sands was paid \$38.69¹/₂ in 1818 for building a wheel house. The furnace paid his board, which amounted to 7.60, during the construction. For \$46.09¹/₂ Hopewell Furnace had a wheel house. The only other construction data we have on the Wheel House (Building 8), if it was the same structure, is dated in 1879. In that year Harker Long, then furnace manager, says that he joined the roof of the Wheel House to that of the Bridge House.

Probably also in 1879, Long built the north wall of the Wheel House (Wall E) a few feet higher. It has been reconstructed to this new height. It's former height was the same as Wall R. Since some of the supports must have rested on Wall R, it must be inferred that the existing supports were shortened, or replaced with new ones when Wall E was built higher. Long does not mention this, however.

It is possible that the Wheel House built in 1818 existed until the 1900's, granting that maintenance as needed was performed. It is also possible that one or more new wheel houses were built, with the information in a lost manuscript.

61

200 3, p. 153

62

Harker Long, verbatim notes by Appleman, 1935, op. cit.

63

Ibid.

Since apparently the Wheel House had a separate roof until 1879, it probably until this time was not joined in any way with the Bridge House. Thus it would have been possible for the 1818 wheel house to have stood while the 1829 and 1847 Bridge Houses were built alongside it.

The purpose of the Wheel House, evidently, was protection for the blast machinery and/or water wheel. Let us review our thinking on the history of the blast machinery. It is thought that from 1770 until circa 1805 that leather bellows, located under the bridge house and powered by a north-south water wheel, provided the blast.⁶⁴ About 1805, the water wheel was changed in location so as to operate in an east-west direction. While it would have been mechanically possible to continue to operate the leather bellows with the wheel in this position, it is more likely that simultaneously with the changed wheel position a new type of blast machinery was adopted. By 1805, Hopewell may have used crude, single action cylinders.⁶⁵ These have been described as consisting of two cylindrical wooden casks, "fitting closely the one into the other, and moving up and down between four wooden posts,"⁶⁶ The four wooden posts may have supported a roof to protect the casks. Perhaps by 1818, the modification of the casks to double action pistons inside

⁶⁴ See NH-60VI-3069, Conjectural Restoration of Early Blast Machinery, op.cit.

⁶⁵ Marjack, Monthly Narrative Report, June 1749.

⁶⁶ Johann David Schoepf, Travels in the Confederation (1783-1784), Trans. by Alfred J. Morrison, Vol. I.

67

wooden tubs had occurred. Since the posts were eliminated by the new tubs, it seems plausible that a structure designed to protect the tubs would be built. The wheel house about which we have some detailed knowledge not only served to keep the tubs and wheel out of the weather, but also appears to have served to retain heat from the furnace, and thereby keeping the frost away from the wheel and tubs longer than it would have been possible had they been exposed. The protection of the blast machinery from freezing weather may have permitted longer operation of the furnace. For the purposes of this report, we assume that the wheel house altered by Long in 1879 was the 1818 structure. Since the roof was the major structural part of the 1818 wheel house, as it usually is with any building, the roof changes made by Long in 1879 probably involved other major changes. Very probably the roof supports on the east (Bridge House) side were eliminated, and new ones replaced the former roof supports on the other sides. We do not know if the 1818-1879 wheel houses were sided or not, and if so, if the siding would serve under the new roof. We must assume that the 1879 alterations, which probably included raising the north masonry wall, were actually the building of a new structure. Some of the old materials may have been used, however. Long evidently thought of the wheel house as existing as an entity throughout. This may be something like the case of the old woodsman who claimed his axe was 60 years old. It had had two heads and three handles, but it was the same axe.

67

See Apple, Documentation for the site, pp. II-119 to II-123.

The 1879 Wheel House:

The 1879 Wheel House was a three sided frame structure which stood on masonry foundations. The fourth side was contiguous with the west side of the 1847 Bridge House, and the interiors of the two were as one. However, the floor of the Bridge House was not attached to the platform on which the tans sat. The portion of the Bridge House floor, on which in 1915 were stored some ore and charcoal carts, probably did not extend to the east side of the 1847 Wheel House.

A door in the northeast corner of the Wheel House, which may be seen in the 1920 Stauffer photograph 125-09, led to a landing inside the Wheel House. From the landing, steps led upward to the blast platform, and downward, along the south face of Wall A, to the lower casting level of the furnace. A handrail may have been present to aid those who used the steps. When the steam boiler was installed in 1880 in front of the south face of Wall A, the steps must have been removed.

Several of the interviewees stated that the Wheel House had a slate roof. Thus, its roof would match the Bridge House roof, with which it was continuous.

68

Long, verbatim notes by Appleman, 1935; Charles E. Stevenson, interview by Gale, Sept. 23, 1940; Charles Sheridan Painter, interview by Euglin, Apr. 15, 1953; Hunter Care, interview by Voorhis, June 24, 1939; Lafayette Houck, interview by Voorhis, June 24, 1939.

69

Charles Sheridan Painter, interview by Euglin, Apr. 15, 1953.

70

C. L. Briston, interview by Apple, June 8, 1956 (he took pictures); Charles Sheridan Painter, interview by Euglin, Apr. 15, 1956; Long, verbatim notes by Appleman, 1935.

BIBLIOGRAPHY

SIBLIOGRAPHY

MANUSCRIPTS

Journals and Ledgers of Hopewell Furnace, 1800-1883.

INTERVIEWS

Care, Charles Sheridan, interview by Gale, Feb. 24, 1941.

Care, Mrs. Daniel (Violet), interview by Gale, Feb. 13, 1941.

Care, Hunter, interview by Voorhis, June 24, 1939.

_____ interview by Kurjack, Mar. 14, 1943.

Care, Mr. and Mrs. Morris Lyman, interview by Gale, Feb. 6, 1941.

Care, Jr., Nathan, and Mrs. and Mrs. Daniel Care, interview by
Gale, Jan. 13, 1941.

Glass, Jacob, interview by unknown, Jan. 3, 1941.

Long, Barker, verbatim notes taken by Appleman, Dec. 1935.

_____, interview by Kemper, Aug. 7, 1936.

_____, comments on notes made during interview of Aug. 7, 1936.

Houck, Lafayette, interview by Voorhis, June 24, 1939.

March, Mr. and Mrs. Samuel, interview by Gale, Jan. 22, 1941.

Painter, Charles Sheridan, interview by Hugins, Apr. 15, 1953.

Stevenson, Charles E., interview by Gale, Sept. 23, 1940.

CHARTS, DRAWINGS, PHOTOGRAPHS

Apple, F. A., Conjectural Restoration of Early Blast Machinery
(1770-ca.1800), Hopewell Furnace, MS-NOVI-3060, Aug. 16, 1956

Cass, J., Profile of Furnace Group, un-numbered, Nov. 9, 1953.

Cotter, John L., Excavation of Charcoal Fill Between Bridge House and
Charcoal House, 1950 Archeological Operation No. 1.

Penniston, J., Sketches, Bridge House Framing, MS-NV-20124, Mar. 1954.

Donohoe, R.P., Profile of Ramp from Center of Charcoal House to Top of Furnace Stack, un-numbered, July 25, 1956.

LeVan, J., Measured Drawing, Historical Charcoal Wagon, June 26, 1941.

Motz, J.C.F., Bridge House Restoration, NRS-MV-2064, Apr. 11, 1942.

Stabler, J., Preservation, Stabilization of Furnace Group, NRS-MV-10,702, Jan. 1942.

_____ Sketches, Bridge House Framing, NRS-MV-2020, 1951.

unknown, Measured Drawing of Hopewell Furnace, RDP-PA-PC-317, Nov. 30, 1936.

unknown, Historical Ore and Charcoal Carts, n.d.

Photographs: 25-8, no data.

125-01, 1887 Stokes,

35-25, 1928 Postcard

101-07, 1896 Bull

125-13, 1911 Lick-Painter

102-05, no data

99-19, no data

122-1, no data

35-26, ca. 1926

47-10, from a postcard, no data.

22-6, 1928 Smith

125-09, 1920 Stauffer

GOVERNMENT MEMORANDUMS, MONOGRAPHS, REPORTS

Apple, R.A., Documentation for the Historical Base Maps, June 5, 1956.

_____, Memo. to Supt., Grade of Bridge House Floor and Approach Ramp; Height of Supporting and Retaining Walls, July 25, 1956.

- _____, Memo. to Supt., Conjectural Restoration of Early Blast Machinery; Drawing No. NBS-NOVI-3040, Sept. 6, 1956
- Appelman, R.L., Proposed Restoration Plan for Old Iron Making Village, French Creek Project, Hopewell, Penna., Jan. 15, 1936
- Cass, J., Memo. to Reg. Dir., Reg. One, Conference June 6-7, June 7, 1950.

_____, and W.E. Hugins, Completion Report on the Restoration of the Water Wheel, Blast Machinery and West Head Race, August 1, 1952.

Hugins, W.E., Early Nineteenth Century Iron Furnaces, A Comparative Study, Jan. 7, 1954.

Kurjack, D.C., Chart of Physical History of Hopewell Furnace, n.d.

_____, Monthly Narrative Report, June 1949.

Schumacher, F.J.F., Archeological Explorations at the Furnace Group 1935-1951, Sept. 1951

GENERAL

Gising, A.C., Ph.D., Pennsylvania Iron Manufacture in the Eighteenth Century, Harrisburg, 1930.

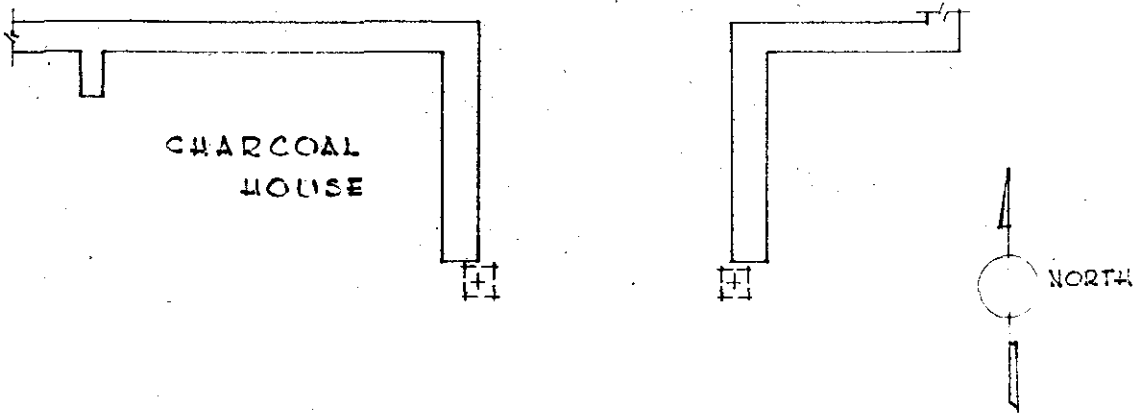
Boyer, C.S., Early Forges & Furnaces in New Jersey, Phila., 1931.

Long, M. A., A Short History of the Hopewell Furnace Estate in Union Township, Berks County, Reading, n.d. (1930).

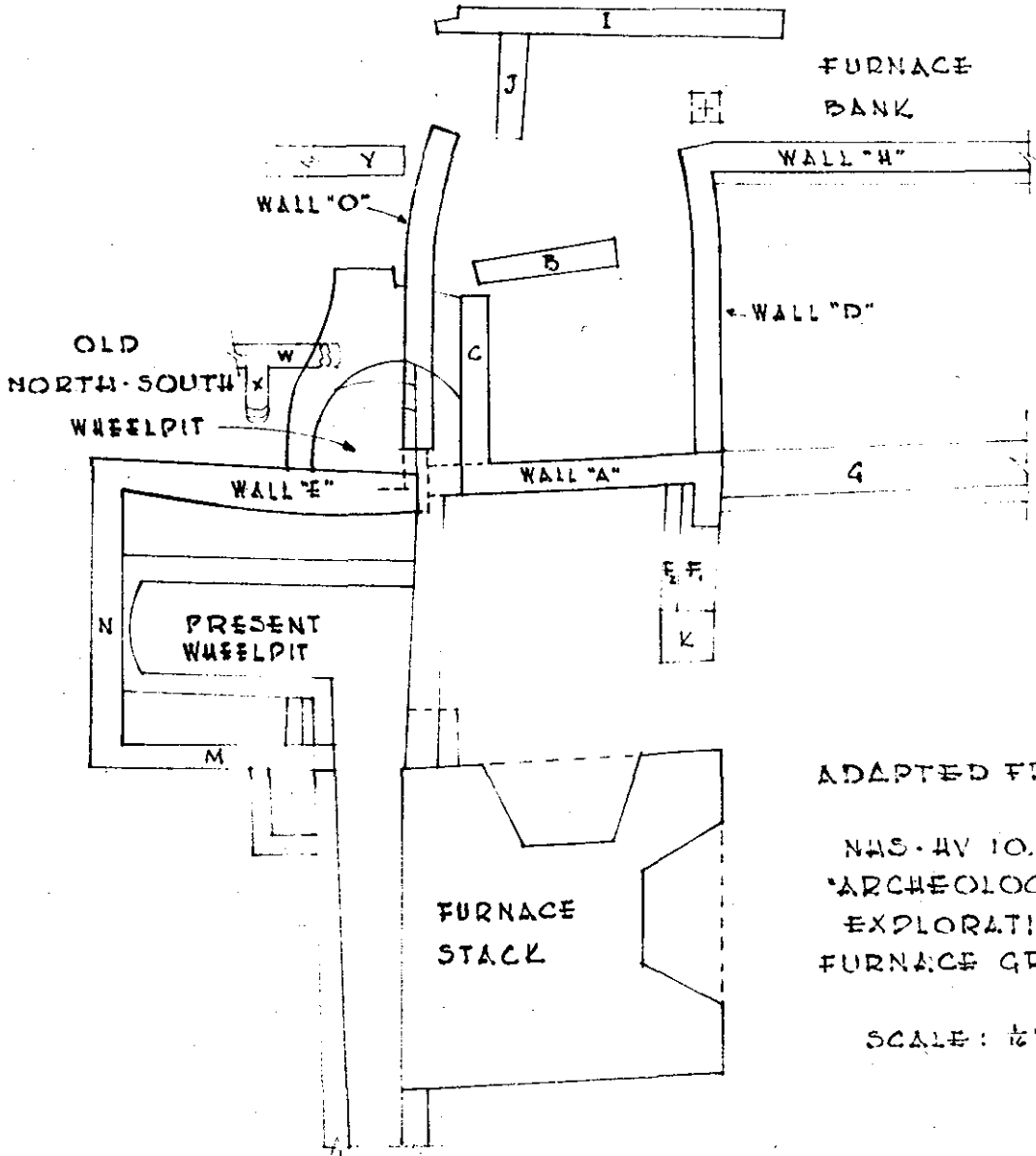
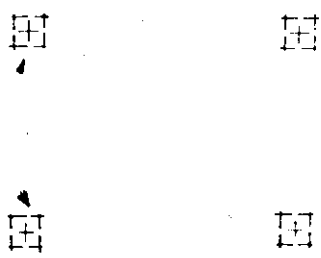
Overman, F., The Manufacture of Iron in All Its Various Branches, London, 1854.

Schoepf, J.D., Travels in the Confederation (1783-1784), Trans. by Alfred J. Morrison, n.p., n.d., Vol. I.

APPENDIX



PORTICO
COLUMN FOOTINGS



ADAPTED FROM
 NMS-4V 10.701
 "ARCHEOLOGICAL
 EXPLORATIONS
 FURNACE GROUP"
 SCALE: 1/2" = 1'-0"



101-07

1896 Bull



1887 Stokes Photo

HI-008

MCNEEL PRINCE NATIONAL HISTORIC SITE
P. O. #1
SWEETEN, PENNSYLVANIA

1887

125-01

1887 Stokes



125-13

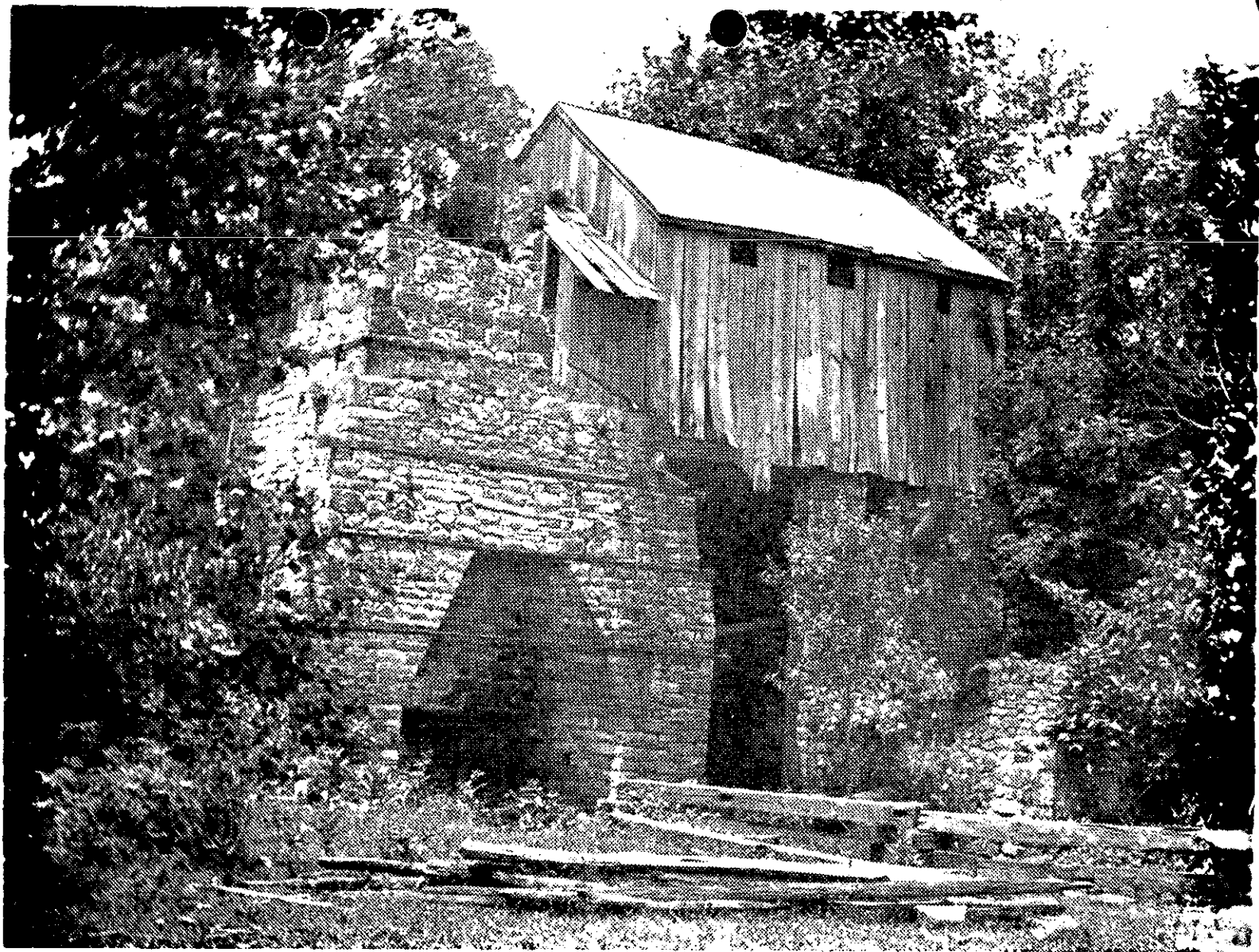
Luck-Printer 1911



1920 Stutter 125-09

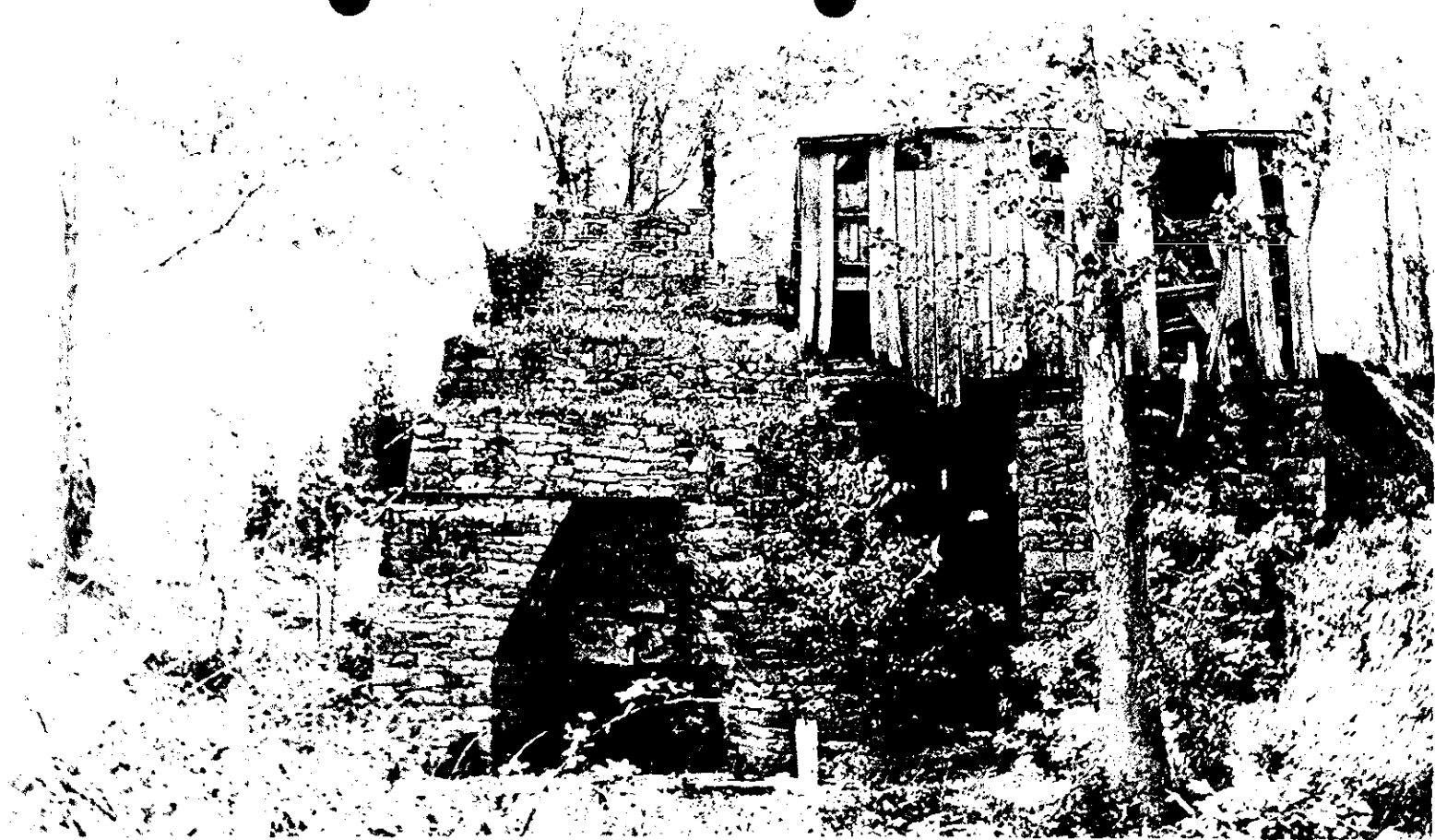
125-09

1920 Stutter

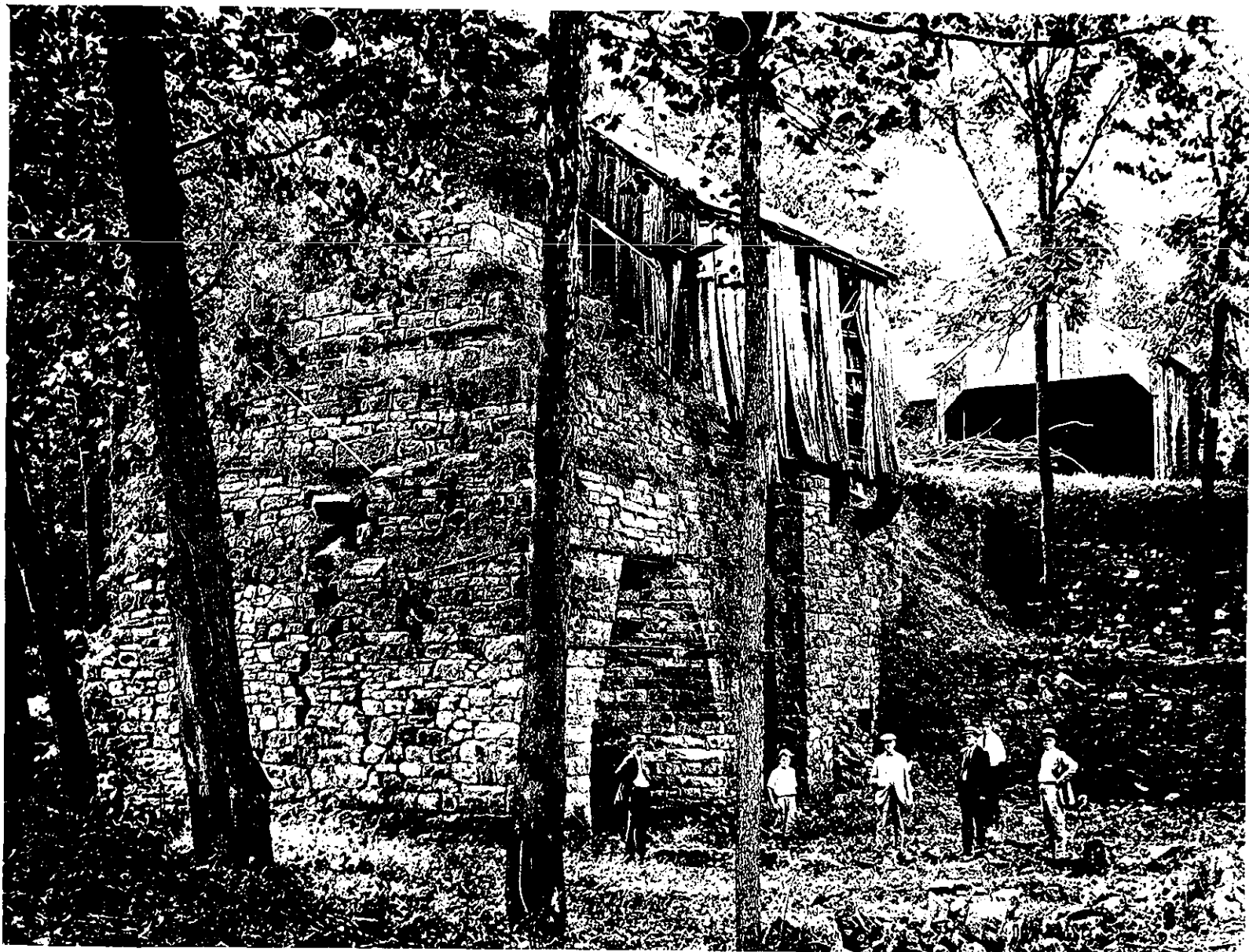


35-25

1928 Postcard



22-6 1928 SMITH



122-1

122-1

After 1920



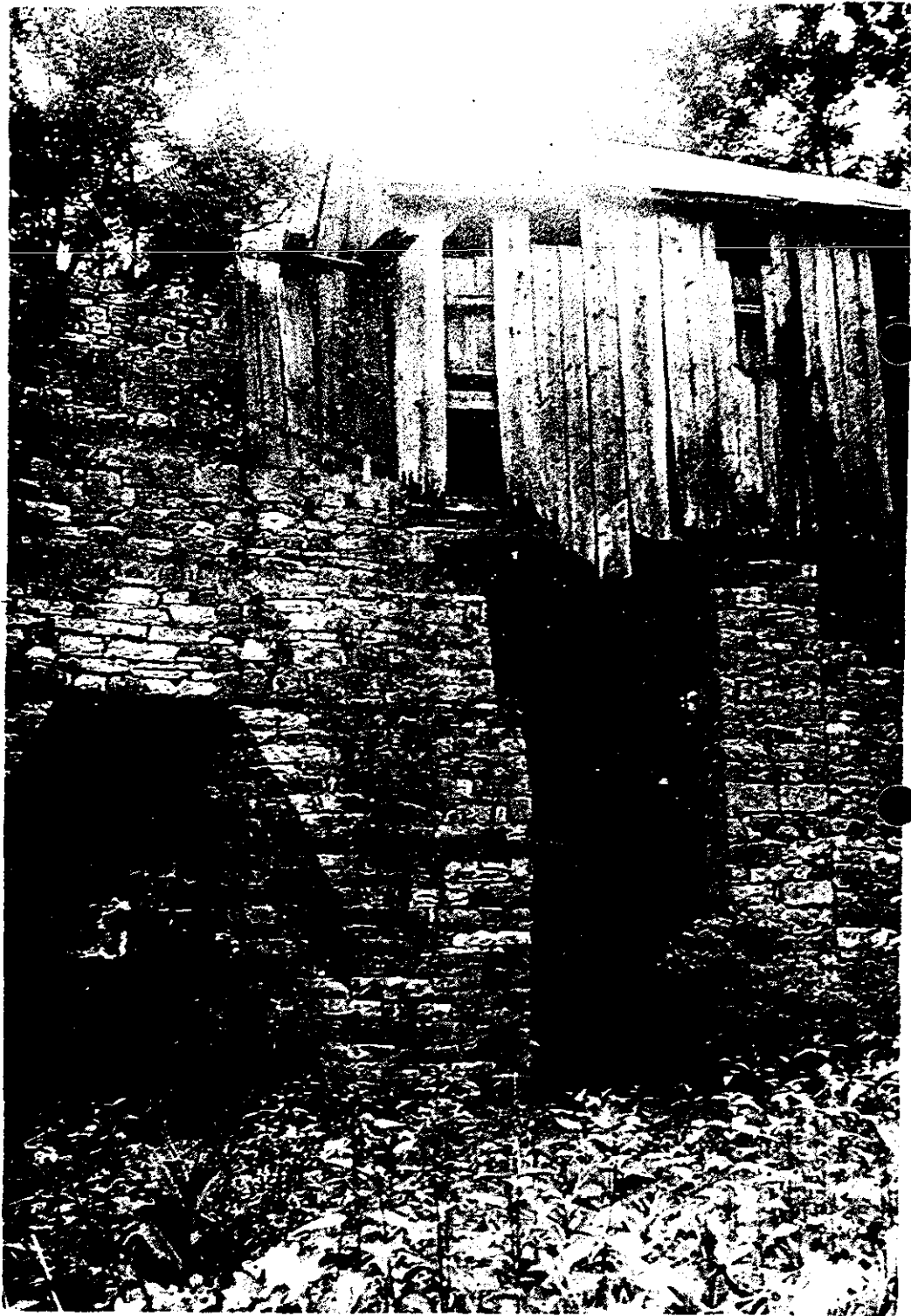
102-5

102-5 After 1920



11-11

99-19



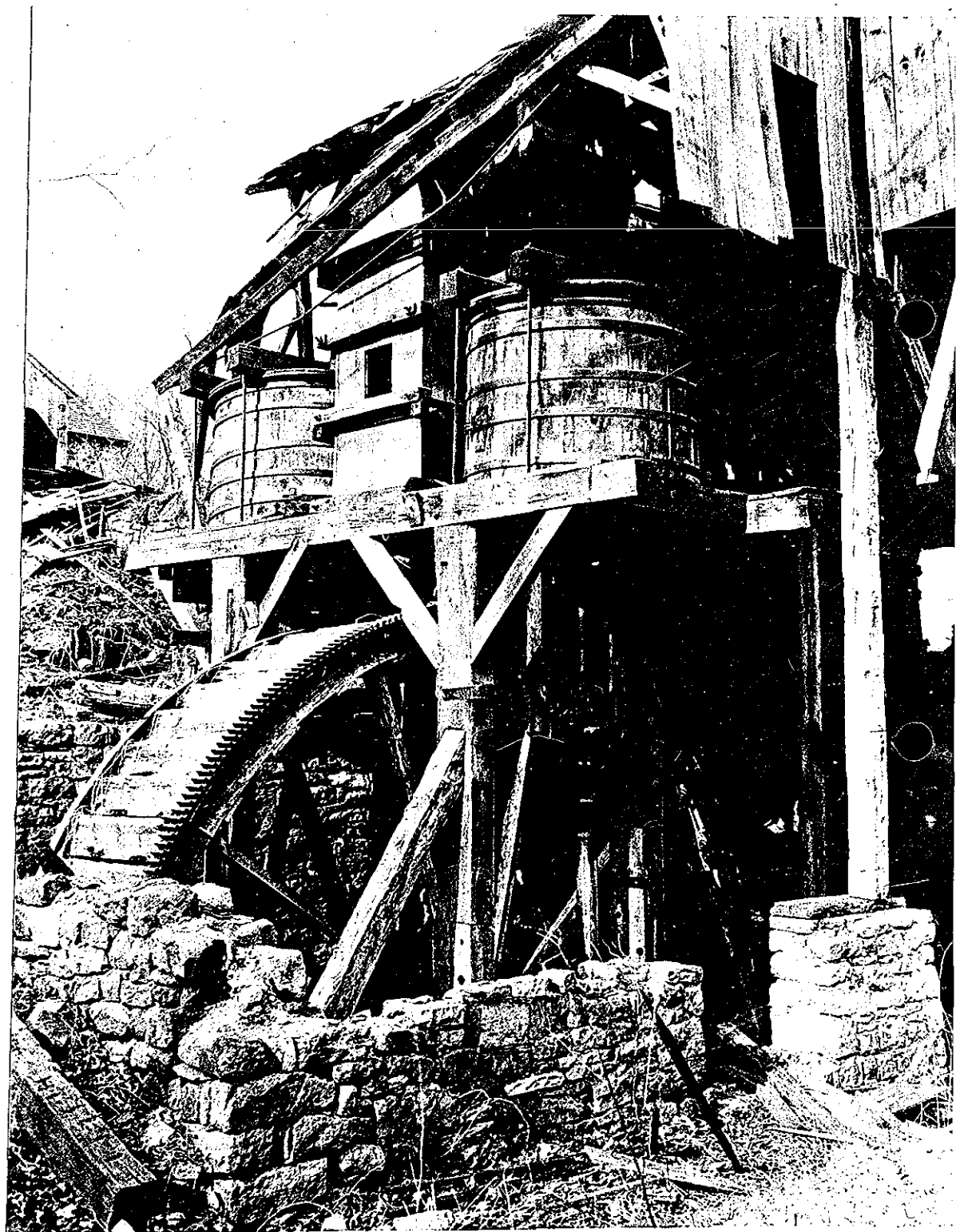
47-10

47-10



35-26

35-26



25-8

25-8