13.1 Opening day crowds on the path to the reconstructed industrial buildings. (Photograph 1270 by Richard Merrill, 1954.)

Evaluating the Reconstruction

William A. Griswold

By the end of the reconstruction, The First Iron Works Association (FIWA), backed almost entirely by the American Iron and Steel Institute, had spent about two million dollars on the project. Two million in 1950s dollars would be worth almost fifteen million dollars today (CPI adjustment), a very generous gift intended to commemorate the birth of the iron and steel industry in the United States. This chapter evaluates how well the Institute's money was spent. Does the reconstructed Saugus Iron Works of today closely resemble the historic seventeenth-century ironworks? To answer this central question, two additional questions must be explored: how accurately were the buildings reconstructed and does the limited reconstruction represent the ironworks of the 1640s?

The Accuracy of the Reconstructed Buildings

From the very inception of the project, the FIWA and the smaller Reconstruction Committee knew that archeological investigations could provide key information to aid in the reconstruction. However, even as plentiful and well-preserved as the archeological record was at the site, the members of these organizations realized that archeology would not provide all the information necessary for the reconstruction. Archeology could locate the various features on the landscape (furnace, forge, canals, etc.), but could not provide information on the height of the furnace stack or how the gears of the rolling and slitting mill functioned. To learn about these details, an enormous amount of historical research was done by several members of the project including Neal Hartley, Charles Rufus Harte, Walter Renton Ingalls, H. R. Schubert, and various individuals associated with the architectural firm of Perry, Shaw, and Hepburn, Kehoe and Dean. These individuals worked in conjunction with many members of the American Iron and Steel Institute who had equally impressive credentials for understanding the historical manufacture of iron. To justify the price tag of the undertaking, the FIWA had amassed the most knowledgeable minds in the business; Saugus was to be the industry's legacy.

Even though the best and brightest worked on the project, a great deal of the information needed for a bottom-up reconstruction was either unavailable or proved contradictory or ambiguous. In these cases (and there were many), the architects were charged with providing the necessary details to come up with a workable solution toward physical reconstruction. The architects' solutions were then discussed and evaluated by the Reconstruction Committee members and/or by the specialists associated with the

Any student of colonial history knows that there were dozens of loudly hailed grand designs and projects, most of which came to naught and stand embalmed in the records only as evidence, now quaint and touching, now grandiloquent beyond belief, of the dreams of pioneers. The New England ironworks, however, became realities, and impressive realities, despite the limited duration of their effective production. One of the Company's agents adjudged them "as good as any worke England doth afoarde." The researches of modern scholars do not seriously weaken his claim . . . . At Lynn, there was a complete ironworks, whose design and engineering were as bold as sophisticated. Here was a huge furnace, a forge comprising two fineries, a chafery, and a big hammer, an extensive water-power system, good storage facilities, workmen's accommodations, and a pier for the use of the small boats which plied the Saugus River laden with the ironworks products. Here was a rolling and slitting mill, the first in the New World, and set up when there were only about a dozen of which we have record in the British Isles and on the Continent. To build all this had taken the willingness to risk of capitalists, the vision of men we today call engineers, the sweat of all but unknown workmen achieving performances of high skill in the working up of timber and stone and iron.

E. Neal Hartley, *Ironworks on the Saugus,* pp. 4-5.

project. Sometimes the committee members and specialists liked the architects' solutions, while at other times they lambasted the architects either for providing too complex a solution or for not having done enough historical research on the issue.

As seen time and again at Saugus, strange things can happen in committees. Some naively believe that committees are primarily egalitarian places where ideas are brought up and discussed in a totally intellectual framework devoid of constraints like money, time, charisma, personality, hierarchical structure, politics, or discipline hierarchy. However, those who regularly serve on committees know that these constraints typically dominate the decision-making process. At times, one can anticipate what arguments will be made by certain individuals or particular groups before the topics are even brought up for discussion. In the end, some decisions that are made in committees are good and some are bad. The Reconstruction Committee at Saugus was no different than present-day committees and as such was governed by a multitude of constraints from personality clashes to intellectual disagreements.

In the project correspondence, it is indeed difficult to distinguish the Reconstruction Committee from the FIWA from contractual specialists. Even though each of these groups had a defined membership, a great deal of overlap occurred. Membership also changed through time, so one has to be very careful to identify the year under discussion. When begun in the early 1940s, the FIWA's membership was small, but it ballooned by the early 1960s. Technically, in 1952, it was composed of J. Sanger Attwill (president), Henry Peckham (vice president), Thomas McNichols (treasurer), Miss E. Florence Addison (assistant treasurer), Miss M. Louis Hawkes (clerk), and nineteen directors, including Walter Tower, Quincy Bent, Edward Bartholomew, Jr., Charles Rufus Harte, Walter Renton Ingalls, and Mrs. F. B. Crowninshield. The Reconstruction Committee was the group directly responsible for getting the Saugus Iron Works reconstruction built. From 1948 to 1953, this much smaller, task-oriented group included Atwill, Bent, E. Neal Hartley, Harte, architects Andrew Hepburn, Sr., and Conover Fitch, Jr., Ingalls, Bartholomew, and Carl T. Emery. Individuals like Roland Robbins, H. M. Kraner, Elso Barghoorn, and H. R. Schubert were considered specialists and while their input on the project was highly valued, they were never considered members of either committee. Hartley, while named as a Reconstruction Committee member in photographic captions, never considered himself a member of either group.

A careful reading of the correspondence makes it clear that there were several camps within the committees. Robbins seemed to get along famously with Charles Rufus Harte and rather well for the most part with Hartley. Robbins did not get along well with either H. R. Schubert or the architects, especially Harrison Schock. The disagreements were sometimes the result of intellectual disagreements but more often than not were simply the result of personality clashes. Robbins seemed to have been the real rebel of the

Even within the smaller working group communication has not always been perfect and there have been fumbles. This I take to be the best evidence in the world for the necessity to have the decision making carried by a small body. As one example of a failure to communication take the furnace bridge. I do not believe that I saw the plans for it in advance of its actual construction. I did see the bellows plans and approved them as coming closest to squaring with Robbins' data of the several versions which they worked out with adequate historical precedents. The fumbles are ab*normal. Normally, to my eyes, we work together quite satisfactorily and what we come up with is a* joint *product. Robbins is not always satisfied. Neither am I. Neither are the architects. But we do the best we can . . . .*

E. Neal Hartley to Charles Rufus Harte, August 20, 1952.

13.2 Members of the Reconstruction Committee pose with iron ring on September 11, 1951. (Photograph 438 by Richard Merrill, 1951.)

group, constantly locking horns with the architects. He was not the only person to question the work of the architects, as a July 24, 1951, letter from Charles Rufus Harte to Quincy Bent illustrates:

> When, some weeks ago, Robbins told me that the architects' representative, one Schock, had said they proposed to tear down the walls [of the furnace] and rebuild them, the idea seemed so preposterous, in view of their condition, that I assumed it was due to the man's ignorance or incompetence, and gave it no further thought. Yesterday, however, I found that not only the comparatively small collapsed section, but all traces of the old masonry had been removed, an act which to me seems little short of criminal.[1]

While not mounting a vigorous defense of the architects, Hartley did believe they were doing the best job they could under the circumstances and even had faith in Schock, as is evident in a letter from Hartley to Harte dated August 10, 1951.

> He has a very difficult situation on his hands in that he is working closely with two people of whom I am very fond but who are possessed of potent Yankee personalities and an almost messianic zeal for the job in hand, Miss Hawkes and Robbins. Few could satisfy the former, and Schock's personality is such that he could not fail to clash with the latter. He means to do well, and he has certainly given the literature a terrific going over before coming up with what he considers sound. He has to be shown but he is not closed to further suggestion or editing of what he has produced. In summary I do not share Robbin's doubts as to the competence of Perry, Shaw and Hepburn in general or of our friend Schock in particular. I do insist that they, like all architects in all times and places, need close supervision.[2]

In many instances, decisions regarding the reconstruction were made by Quincy Bent, the chairman of the Reconstruction Committee and key contact for the American Iron and Steel Institute. It was Bent who called the shots for the project and without his seemingly dictatorial style of decision making, it is unlikely that the ironworks reconstruction would have ever been completed.

One Reconstruction Committee member in particular, Charles Rufus Harte, was very dissatisfied with Quincy Bent's leadership. Ultimately, Harte became so disenchanted with how the committee worked that he resigned. Hartley's letter to Harte dated August 20, 1952, is especially informative about the workings of the committee.

. . . . In line with our conclusions reached yesterday:

1. Proceed with the furnace lining as shown on our drawings with the circular and not square lining, in spite of the recommendations of Dr. Schubert, which I think are entirely unreasonable. . . .

Quincy Bent to Conover Fitch, Jr., August 29, 1952.

13.3 Louise Hawkes and E. Neal Hartley looking at a scapbook in the Iron Works House, January 31, 1950. (Photograph 144 by Richard Merrill, 1950.)

I cannot tell you the proper functions of the Restoration Committee. It was established before I became connected with the project. In my judgment neither Robbins nor I hold membership on it. Robbie thinks he does. I think he failed to notice a line on the basic organization chart which separates the Committee from us who are hired hands, so to speak. Certainly, in my understanding, Mr. Bent runs the job and bears full responsibility for all decisions so far as the Iron and Steel Institute is concerned. And since they are paying the fiddler their authorized agent must in all propriety be allowed to call the tunes. The relationship between the Institute and the First Iron Works Association has never been clear to me. As things have worked out, however, I should say that Mr. Bent has called on certain especially interested and qualified members of the Association and of the Reconstruction Committee to ponder, deliberate, advise and recommend rather than to "pass on" construction decisions. I am sure that he will make available to them complete information on all developments. Certainly we all of us want their help. As I see it, however, if all plans and drawings had to be formally approved by the whole Reconstruction Committee or even by a smaller effective nucleus thereof the whole job would be slowed down dangerously. Efficiency and common sense seem to require that the decision making be carried by a small group of men all right on tap here most of the time, all familiar with all the aspects of the whole job in hand, under a Chairman who is simultaneously looking out for the interests of the steel industry, the Association, and the general public, in last analysis the people for whom the work is being done. If members of the Association feel that they are being outvoted or shortchanged in any way I'm afraid I'd be impelled to point out to them that few civic minded groups have been the recipients of such largesse as the Association is getting thanks to the decision of the steel industry to commemorate its effective beginnings by restoring Hammersmith.

And if the industry has been generous in carrying the job in the name and legal title of the local group it has been, I think, unusual in the democracy of decision making. Mr. Bent has not and does not act as a dictator. What happens is roughly as follows. Robbins' and my data are fed to the architects. They come up with a plan which squares as nearly as possible with these data and makes sense in terms of engineering efficiency and the long-range plans of a restoration which will be an outdoor museum, so to speak. The plan in question is discussed, and disagreements reconciled as well as they can be, in a meeting of the working group of architects, historian, archaeologist and Mr. Bent. In the case of a major unit such as the furnace the nucleus of the Restoration Committee joins the working group in another meeting in order that their reactions may be obtained, their criticisms registered, etc. [3]

What comes out of the whole will not satisfy all of us. It will be as close to consensus of all concerned as it is possible to make it. In the case of matters of detail I think that Mr. Bent has been convinced that decisions of the working group which met his own approval could stand on their own. In all of this the decision making has been democratic and as well informed as our talents and energies could make it.

E. Neal Hartley to Charles Rufus Harte, August 20, 1952.

13.4 Charles Rufus Harte (front) examines the remains of the waterwheel, June 30, 1951. (Photograph 370 by Richard Merrill,1951.)

Why go into so much discussion about the various committees and individuals associated with them? When dealing with reconstructions, especially those based on archeological evidence, visitors seem to think that archeological excavation somehow provides an exact blueprint for the reconstruction. Visitors generally assume that even the smallest details of the reconstruction are based on something that was recovered from the archeological excavations, like those of Pompeii. In actuality, information necessary to rebuild comes from a variety of sources including archeology, history, maps, and photographs, as well as the knowledge of learned people who have studied the site or time period. Reconstructions in other words are best guesses at what something like Saugus Iron Works was like rather than a precise blueprint derived from any one particular source. Evaluating the accuracy of a reconstruction must be based on how well it reflects the past given the evidence available when the reconstruction was done. The section below provides a review of the information used to reconstruct the major buildings at the Saugus Iron Works including the furnace, forge, rolling/slitting mill, and associated structures, and evaluates how well they reflect the past.

Buildings Reconstructed

Furnace

The first ironworks building to undergo reconstruction was the furnace. As discussed in Chapters 3 and 5, Robbins identified numerous features connected with the furnace, including the size of the base and the geographic location and details of the furnace stack, drainage system, crucible, waterwheel, wheel pit, bellows, hearth, casting areas, and tailrace. Of all the industrial components at the Saugus Iron Works, the furnace was the best documented and most researched. Yet, even with the large amount of archeological and historical research done on the furnace, many details associated with the reconstruction required some educated guesswork. A lot of this speculative work took place at frequent, but not necessarily regular, Reconstruction Committee meetings. Regular attendees at these meetings usually included Bent, Hartley, Robbins, Attwill, Hepburn, and Fitch.

The Reconstruction Committee used a great deal of backward engineering to determine the features of the furnace. For example, even though the exact height of the furnace stack was not known, Hartley's historical research uncovered a letter that pegged the output of the furnace at one ton per day.[4] From this figure, which he interpreted to be the long ton (2,200 pounds), he believed that castings from the furnace were done twice per day. This amount of cast iron was more or less accepted by the members of the Reconstruction Committee. However, Robbins believed that there was not enough physical space within the casting area to fit the 1,100 pounds of iron that were drawn from the furnace during each tap.[5]

Hartley phoned this P.M. and asked what I thought the average length of the sow bars were. I told him the largest one found was 52 1/2 inches long, weighing 290 pounds. He seemed to think they never exceeded the one ton a day capacity that Governor Winthrop mentioned in a letter to a friend. He believed this would be based on the long ton of 22 hundred pounds. I asked him how many tappings a day took place. He said that he believed that only two *castings a day took place at the furnace. If this was the case then each casting would produce 11 hundred pounds of pig or sow iron. I don't think this was the case. The largest bar that we have found was 52 1/2 inches long, 9 inches wide and 4 inches thick and weighs 290 pounds. If the furnace had but two tappings a day, each of 11 hundred pounds, each casting would produce about four times as much iron as we find in this bar. In the first place the casting bed is not wide enough to permit the casting of four bars side by side at a time. If it had two of these bars side by side at a time it would mean each bar had a length of about eight feet, nine inches. I doubt that the sow casting bed would accommodate a bar of such a length . . . .*

Roland Robbins, "Saugus Ironworks Daily Log - 1953," May 11, 1953.

13.5 Visitors looking at the reconstructed blast furnace, September 29, 1956. (Photograph 1373 by Richard Merrill, 1956.)

Hartley's textual discovery led others to begin to sketch out the size, shape, and amount of materials necessary to keep the furnace in blast. Based on the dimensions of the foundation and the production estimate of one ton per day, Walter Renton Ingalls, Reconstruction Committee member, estimated that the furnace was probably about 18 feet tall from hearth to tunnel head and about four and a half by six feet at the bosh. This size would allow the production of seven to eight tons of iron per week. [6] H. M. Kraner, a ceramicist with the American Iron and Steel Institute, speculated in a September 29, 1950, letter to Charles M. Parker, an Institute metallurgist, that the furnace was probably about 20 feet high and approximately five feet in diameter at the bosh and consumed 371 cubic feet of burden and fuel per day.[7]

Numerous decisions were made in the committee that had bearing on the reconstruction of both the exterior and interior of the furnace. Much to the displeasure of Harte and Robbins, the original exterior walls of the furnace were dismantled and then rebuilt using most of the original stones except for those on the top of the platform.[8] The stone used to finish off the top of the platform came from Rockport, Massachusetts, and was selected because it blended well with the local Saugus stone.[9]

Like the exterior stonework, several challenges faced the Reconstruction Committee over the interior of the furnace. One of the challenges concerned the finish of the lining. Samples of finished stone for the liner were solicited from several different companies. Most of the samples that the Committee received were regarded as far too well finished. A memorandum from the September 5, 1952, meeting of the committee notes that "it was emphasized that [the] original lining stone would have been hand-split at [the] Iron Works and would be quite crude. Therefore all appearance of machine finish and cutting should be avoided. As Prof. Hartley has said we can err drastically in making the lining too "Slick" and well finished. We could hardly err in making it too rough."[10] A rough-cut stone was therefore chosen to approximate the examples uncovered by Robbins.

Another issue of debate amongst Reconstruction Committee members was the shape of the boshes. Schubert had expressed the opinion on several occasions that the boshes for the furnace should be square. Hartley's research, however, could not confirm whether early boshes were square or round. The issue was discussed at a July 17, 1952, meeting held at the offices of Perry, Shaw, and Hepburn, Kehoe and Dean.[11] Ultimately, the furnace was constructed with a circular bosh.

In addition to decisions made about the size, shape, and finish of the furnace stack, many other decisions were needed regarding related features of the furnace. One feature that was consciously left out of the reconstruction was the bridge house. Schubert strongly felt that there would have been a bridge house covering the charging bridge, a belief based on examples at the Cannope and Parke furnaces.[12] The Bridge House would have provided protection to the ironworkers and the furnace supplies during

Mr. Attwill again questioned the use of vertical boarding on the roof of the casting and bellows shed. I told him that our research definitely indicates that "purlin Roofs" with vertical boarding were in common use in the early 17th century as well as "rafter roofs" with horizontal boarding and that the former are apparently considered the earlier type, although the development was not always strictly chronological. In any event "purlin roofs" were common in England in barns and other rough structures.

Minutes of the Reconstruction Committee, September 25, 1952.

13.6 The blast furnace during reconstruction, September 7, 1951. (Photograph 435 by Richard Merrill, 1951.)

inclement weather but would also have increased the likelihood of fire. Ultimately, the Saugus reconstruction was completed without a bridge house.

Numerous other decisions about the furnace made in committee included using a round rather than a corbelled arch;[13] a small casting house without sides, just large enough to cover the casting beds;[14] a double versus a single tuyere;[15] a one-foot, six-inch-high tuyere, a one-foot, six-inch crucible with a five-foot diameter bosh, and a 21-foot overall height for the furnace.[16] These decisions were made with the best information available at that time and by the best minds in the business after much discussion. When looking at the furnace, one must be mindful that much of the reconstruction was a direct result of decisions made in committee rather than the result of archeological or historical discovery.

Forge

The Reconstruction Committee expended an equal amount of effort on the reconstruction of the forge. Just to the east of the furnace, Robbins found the archeological remnants of many elements of the forge, including the headrace and tailrace, two wheel pits, foundations for the finery, chaffery, and hammer (along with the hammerhead), and the enormous foundations for the anvils. The height of the building, type of roof, height of the stacks for the finery and chafferies, and other details were not revealed by archeological or historical sources but nevertheless had to be determined to bring about the reconstruction.

The preliminary design for the forge had been produced by the architects based almost entirely on historical information provided by Schubert and Hartley. As this preliminary design included just one anvil and power hammer, Robbins' 1952 discovery of a second anvil threw the plans into question. Schubert wrote to Hartley in a September 10, 1952, letter that the discovery was to be expected.

> I was pleased about the discovery of the second anvil base because it fits in very well with the plan of the forges we all approved on July 7th, & the plan I received from Mr. Fitch last week confirms it. Just near the fineries—where it should be! It is quite in keeping with many 17th-century inventories in which 2 anvils are referred to. Such a second anvil however most certainly does ***not*** require a second power hammer. I'll send you a more detailed report on the use of the second anvil a few days later . . . .[17]

The architects were not pleased with this reaction to the discovery of the second anvil base and A. H. Hepburn wrote to Schubert on September 23, 1952:

> You suggest in your letter to me, and in a recent letter to Mr. Fitch, that this second anvil base fits in exceedingly well with our first approved plan. You feel it would not

Tuesday, July 29 [, 1952] . . . . Last but not least, another anvil base has been found at the finery. It appears to have a 42" diameter, similar in width with the other finery anvil base. This was found handy to the southwest corner of the hutch of the wheel pit of the second waterway crossing Bridge Street. It was about 9' south of the south side of the stone wall running from the west side of the wheel pit on the second waterway in a westerly direction. This stone work had natural clay to its northerly side with Iron Works working floor abutting its southerly side. This stone evidence and its working floor was found during Dr. Schubert's visit. It was this area that Dr. Schubert would not accept as being contemporary with the Iron Works. It was not accepted by Dr. Schubert because he could not find a place for it in any of his plans of contemporary British Iron Works.

Roland W. Robbins, "Saugus Ironworks Daily Log - 1952," July 29, 1952.

13.7 The forge during reconstruction, February 27, 1953. (Photograph 819 by Richard Merrill, 1953.)

have been provided with a power hammer but would presumably have been used for an anvil serving operations carried on with hand hammers. Unfortunately, the construction of this second anvil base is such that it is not reasonable to believe that it could ever have been installed for anything less than a power hammer. As we wrote you on August 27th, it is a very large block of oak, every bit as heavy as the first. It was sunk into the earth a foot deeper than the other anvil base, had even larger cross timbers under it and was provided with an elaborate arrangement of tenons locking it into the base timbers and had a heavy iron band around the bottom—features of advanced workmanship, suggesting the anticipation of very heavy duty for the block, which were lacking in the base first discovered.

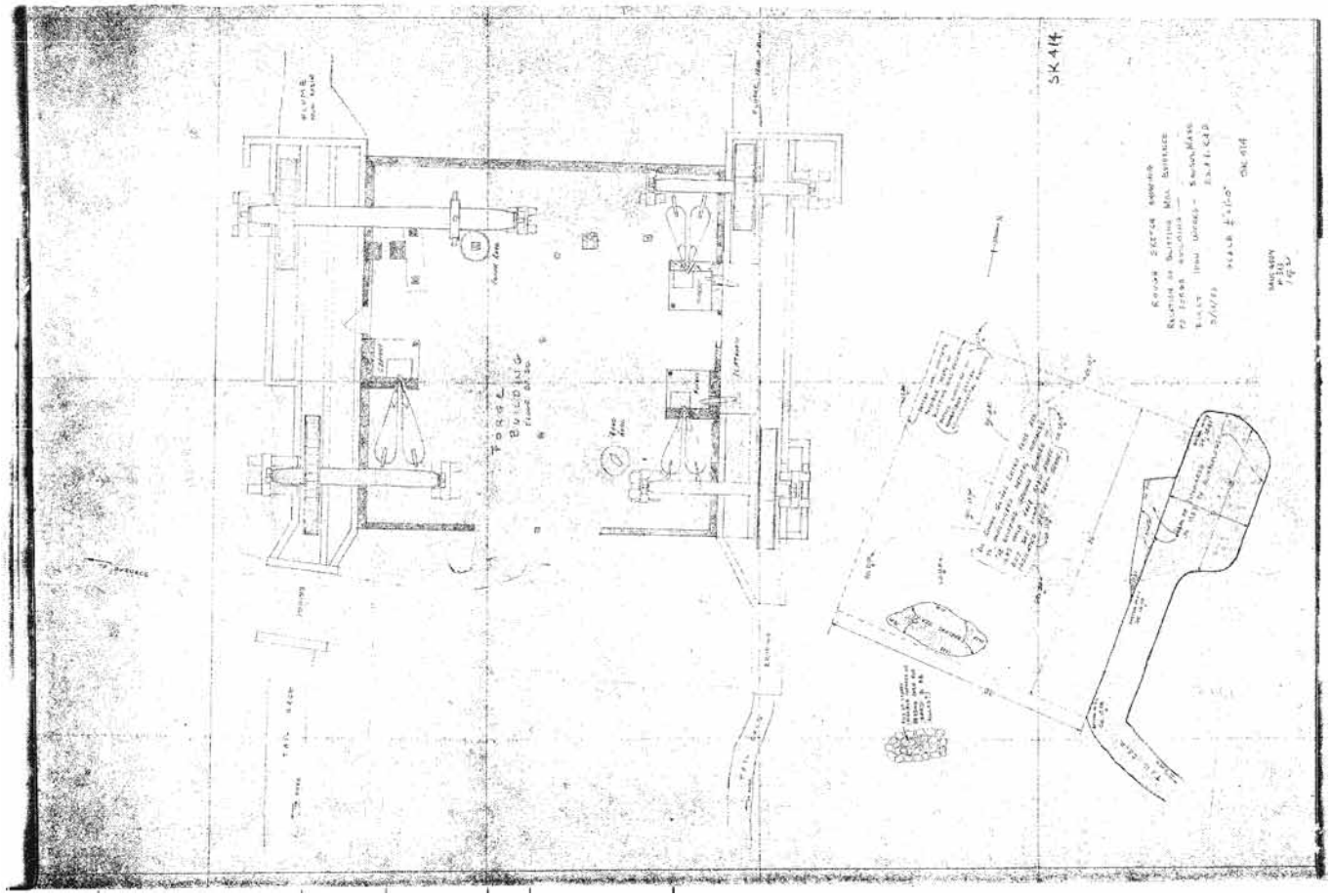
Since our letter to you on August 27th, Robbins has found the imprint of a very large upright post about 14 feet west of the new anvil base. This upright bears the same relation to this base as does a similar upright to the anvil base found earlier, and they both would appear to have been end supports for large overhead "dromes" for power hammers.

Everyone here agreed that we were faced with the fact that there had been two power hammers in the forge area at Saugus. What was not so clear was whether or not they were ever in use at one and the same time. Negative evidence in the documents had always suggested one hammer only during the period of maximum operations, although there are confusing references to new hammer beams, wheels, anvil blocks, etc., and it is possible to infer from the records that a second hammer could have existed. Naturally, we did not want to discard one of the hammers without good reason. The best single reason for deciding that one of them must have been abandoned in favor of the other is the fact that the physical limitations in the size of the forge area and the arrangement of the water courses and wheel pits prevent us from working out any two-hammer layout in which two fineries and a chafery are also included and arranged in a manner satisfactory to us all. We have developed six interim plans in an attempt to evolve a two-hammer forge which made sense. All that we have proved is that the Saugus Forge could not have had two hammers at any one time and have also contained the two fineries and one chafery which are so clearly indicated in the inventories . . . .

There is much that is confusing in the archaeological evidence, but it has become increasingly clear that the anvil base in the southeast corner was the earlier of the two and that the anvil base in the northwest corner was not installed until after forge activity had gone on for some time. This reinforces our present theory that the first power

Mr. Bent directed us to go right ahead full speed on Forge to get as much done this fall as possible. He suggested we should get building closed in before cold weather so that work could go on within Forge during winter months. (N.B.: Work on wheels, etc. will probably best be done in Contractors [sic] *shop building.) Mr. Bent asked that we mail latest sketches of Forge to him at Bethlehem. Maintain first priority on the Forge work. Let nothing else take precedence. Robbins to continue investigation at south end of two forge wheel pits and to east of Forge.*

Minutes of the Reconstruction Committee, September 25, 1952.



13.8 Drawing of final forge layout by Perry, Shaw, and Hepburn, Kehoe and Dean, 1953. Note evidence found for slitting mill and its relationship to the forge.

> hammer was abandoned about 1652 and a new one erected in the northwest corner on the site of a finery which was itself removed and later rebuilt at the southeast corner in the place where the first hammer had been. Apparently, the first hammer was removed in very early times by the iron workers themselves, judging from the evidence in the hole where the large "drome" support must have been. But apparently, also, they choose to leave the first heavy anvil base where it was and use it for supporting a hand anvil. This would fit in with your thoughts that they might well have needed such a second anvil not connected with a power hammer . . . .[18]

It was, therefore, decided to build the forge with only one working hammer and anvil. Minutes from an August 28, 1952, meeting of Bent, Hartley, Robbins, Hepburn, and Fitch indicate that pressure was building to complete the project.

> Mr. Bent emphasized that we must proceed with construction now even though it may later be proved that we have made mistakes and have not interpreted the evidence properly. He said that if we do find we have made mistakes later that we can then consider making changes. He asked that we make every effort to work out the design of the wheels so that they bear a convincing relation to the features of the watercourses and pits.[19]

Robbins was not happy with the final scheme, but was rather powerless to modify the plans. The architects were very critical of Robbins and his work at the forge during the August 1952 meeting. He notified Charles Rufus Harte of his discontent with the chosen design in an August 29, 1952, letter.

> Yesterday's meeting doted on the forge layout. Much maneuvering has been done to erect two forges [fineries], a chafery and a couple of anvil bases in the area we believe to show the bounds of the forge layout. No maneuvering on the part of Hartley and the architects can incorporate two hammers at the forge. As such, it has been decided by Hartley, the architects and Mr. Bent that the forge layout contained, when in operation, but one hammer. The second hammer site found recently they believe to have been an early site of the hammer which was discontinued when a new hammer site was decided upon. I am the lone dissenter on this theory. I will not annoy you at this time with the details concerning my reasons for believing the way I do. [20]

Any evaluation of the forge needs to take this dissent into account. The forge was reconstructed with only one working hammer even though Robbins uncovered two anvil bases. The decision to reconstruct the forge with only one hammer was determined by the best fit of all the evidence including archeologi-

Work is to proceed as rapidly as possible on the single-hammer layout based on Scheme "H", SK 324, scheme to be modified to allow chafery wheel to make better use of the waterway possibly in the manner shown in Scheme "J", SK 318A. Robbins is to clarify all evidence in the Forge area and attempt to find new pertinent evidence. It was agreed that in putting in the concrete retaining and foundation work the south end of the Forge would be left open as long as possible for further exploration. Together we are to work out satisfactory finish grades for the perimeter of the Forge area and for the working floor within the Forge. Of this latter, it was agreed that a slight slope of approximately 1'-0" from north to south be acceptable but not a marked change in grade.

Minutes of the Reconstruction Committee, August 28, 1952.

13.9 Reconstructed hammer and anvil in the forge. (Photograph 926 by Richard Merrill, 1953.)

cal, textual, and, physical design constraints. This decision does not mean that two hammers did not exist at the same time, only that a preponderance of the evidence points to only one hammer in operation at a time.

Rolling/Slitting Mill

Whereas substantial archeological information was preserved at both the furnace and the forge, far less evidence was available for the reconstruction of the rolling/slitting mill. Robbins' had located the wheel pits for an unidentified building. He and the members of the Reconstruction Committee chose to reconstruct this building as the rolling/slitting mill because of three key pieces of evidence: historical reference to a rolling/slitting mill in operation at Hammersmith; lack of anvil foundations within the building footprint; and the location of a partially slit piece of metal, colloquially known as the squid, in the immediate vicinity. Together these components provide a compelling case for reconstruction of the rolling/slitting mill on this site, but the case is by no means conclusive. A July 6, 1953, memorandum from a meeting at Quincy Bent's house in Annisquam attended by Bent, Attwill, Hartley, Robbins, and Hepburn suggests the tenuous nature of the evidence:

> It was the consensus of opinion that there was no evidence whatsoever as to the plan of this building: the only evidence as to its location is the excavated area which in size and shape suggests a hutch for two wheels.[21]

I noticed the slitting mill proposed has 2 chimneys & therefore apparently 2 furnaces, thus resembling a slitting mill as it was in Sweden around 1780, but not like an English mill of the 17th century which had one furnace only, see Plot (1686), p. 163. I am very doubtful whether there was space for 2 water wheels as such a wheel was pretty wide (comp. Smeaton's design for Kilnhurst Forge: 4'4" wide). Of course it depends on further archeological findings, & I think neither of us can do or suggest much before Mr. Robbin's [sic] *excavations will be more advanced.*

H. R. Schubert to Conover Fitch, July 30, 1953.

Two aspects to the archeological evidence never fit especially well with the reconstructed rolling/slitting mill. First, the orientation of the footprint of the building differed from those of the other two industrial buildings on the site. No one was ever able to satisfactorily explain why the building was sited differently. Second, two saucer-like depressions were found to the south of the wheel-hutch (compartment built to contain the waterwheel), the eastern one filled with lime. Robbins thought that perhaps the lime-filled depression was connected to some type of smelting activity, possibly associated with a bloomery. However, Hartley was emphatic that the presence of lime meant that it could not be part of the rolling/slitting mill. [22] A large charcoal deposit just to the north of these saucer-like features could never be satisfactorily explained, adding to the uncertainty.

The rolling/slitting mill thus was a very speculative reconstruction compared to the other two buildings. This reconstruction was a best guess of how a seventeenth-century rolling/slitting mill would have looked and functioned. While historical research provided examples of other rolling/slitting mills around the world, archeological excavation and the artifacts uncovered nearby (e.g., the squid) revealed little other than the basic footprint of the building.

13.10 The slitting mill under construction, December 21, 1953. (Photograph 1081 by Richard Merrill, 1953.)

Other Reconstructed Features

Several of the other features reconstructed at the Saugus Iron Works, like the head and tail races for the various waterwheels, were almost entirely based on archeological discoveries. Because the reconstruction so closely followed these discoveries, there is not much discussion of it in the records of the FIWA or the Reconstruction Committee. The extraordinary photographs taken at the time of discovery and Robbins' descriptions of the finds indicate that the reconstructions of these features very closely resemble what he found in the field in terms of both their location and their reconstructed appearance. Many of these reconstructed features, however, have concrete bases covered by a wooded veneer, but the reconstruction accurately communicates the look of the original to the visitor.

Other features require a little more scrutiny to assess their accuracy, such as the turning basin, the bulkhead, and the dock. Robbins excavated this area intermittently between 1951 and 1953. His terminology for the discoveries is somewhat confusing in that he refers to the bulkhead as the yard sills. This long and heavily built east-to-west-oriented structure lined the southern extent of the site and separated the land from the water. The text and the photographs from Robbins' excavations illustrate its characteristic features, its construction, and its location. Robbins' notes also indicate that a small boat basin was found between the slag pile and the western end of the wharf.[23]

. . . Continued following large beam running north from near west end of yard-dock sill and sheathing. This appears to run for some distance. About 12' north of its southerly end, we encountered across member headed east-west. To the northerly side of it is an upright. This has not been complete excavated. However, the upright may be driven through a hole in the large beam acting as a pin to hold the large beam in place. It may prove to be some form of dead-man . . . .

Roland Robbins, "Saugus Ironworks Daily Log - 1953," March 27, 1953.

While Robbins and Whittlesey identified a stone feature at the western extent of the bulkhead, its identification as the dock or wharf seems to have been somewhat speculative. Robbins reasoned that

> the answer to why that end of the yard-dock area had been developed may be found under the slag dump, just south of the westerly end of the yard-dock sill, and west of the dock basin. It is possible that during the early development, the boats were unloaded from the westerly side of the dock basin. Later on, when a decision was made relative to the course of the slag dump, which was to include the possible early site of the dock, then the stone wall was built above the yard-dock sill to the easterly side of the basin, creating a new wharf on the easterly side of the basin.[24]

Logistically speaking, an ironworking operation like Saugus would have needed a dock or wharf to accommodate boats. While the evidence is not conclusive for the location of the dock or wharf, Robbins makes a good argument for it being just to the east of the boat basin, so that the reconstruction of the dock appears reasonable.

Some discussion did take place at the time about the level of the sill of the bulkhead and dock. The reconstructed level would ultimately affect the appearance of the entire turning basin. Robbins captured the dilemma when he wrote that

13.11 Basin bulkhead under construction, November 9, 1953. (Photograph 1051 by Richard Merrill, 1953.)

> we are seriously considering the elevating of the yard-dock sills to the level of the present river bed. To do this would mean that there would be less contrast between certain restored areas. If we restore the river bed of three centuries ago, where it abuts yard-dock areas, etc., it means this area will be about three feet lower than the present river bed. It will always be under water, even when the tide is out AND THE PRESENT RIVER BED IS DRY. This will convey the impression that a body of water (similar to the basin) existed over a large area. To elevate the base sills of the yard-dock area, as well as the westerly waterway from forge, etc., to the elevation of the present river bed, which is about at el. 8., would mean the entire river bed would be visible when the tide was out. The river bed would abut the yard-dock area, etc., and the restored basin would be clearly defined by its pool of water.[25]

Ultimately, the Reconstruction Committee decided to elevate the bulkhead and dock.[26]

While Robbins mentions excavating a warehouse feature several times in his daily log, the reconstructed warehouse appears in a different area on the site than where Robbins reported finding the foundations. These inconsistencies can be seen by comparing the earlier maps done by surveyor John Bradford and the later maps illustrated by Whittlesey. Robbins' excavations for the warehouse seem to have taken place on a larger structure northeast of the reconstructed warehouse. The warehouse, perhaps never viewed by the Reconstruction Committee as crucial to the reconstructed ironworks, may have been located adjacent to the dock and wharf area more out of convenience than historical accuracy.

Proceeding easterly from the west end, the wall becomes less self-supporting, leaning back on the fill behind it with an increasing batter resembling a steeply and closely fitting rip-rap. For the most part there was only one layer of stone. The stones becoming progressively smaller toward the upper part. The wall has been removed and the stones set aside in a separate pile.

Stephen Whittlesey, notes, September 10, 1953.

The Reconstruction as Representative of Early Ironworks

While there were several controversies over the reconstructed buildings, in the final analysis the Reconstruction Committee did an admiral job with the reconstructions. It invited input from a variety of different disciplines and used all accurate information provided to aid in the reconstruction. Numerous elements affected the reconstruction. When archeology and history were silent, the architects and iron and steel industry representatives had to take their best guess at what a feature or building looked like and how it functioned. Overall, the reconstructions were good to very good.

One major critique of the project lies not with the reconstructed buildings and features, but with the failure to reconstruct buildings and features that were identified. This comes to the very core of answering the question of how well the site as a whole simulates a seventeenth-century ironworks. Very significant buildings, including all of those buildings associated with ironworker Joseph Jenks, the charcoal house, and the holding pond, were never reconstructed. In addition, numerous other buildings mentioned in the various inventories were never identified archeologically (primarily worker housing). This no doubt

13.12 The dock under construction, January 29, 1954. (Photograph 1107 by Richard Merrill, 1954.)

stemmed from a lack of money devoted to additional reconstructions. A January 9, 1951, letter from Quincy Bent to Conover Finch indicates that Bent had a notion to reconstruct the charcoal house on the Lovell lot and was leaving a space open for the Scotch-Boardman House, a seventeenth-century house also located in Saugus, in case a deal for the house could be made.[27] Without these features, however, visitors have a distorted sense of the original landscape of the ironworks.

Another critique of the project concerns the current configuration of the top of the plateau behind the Iron Works House. If Hartley's estimates were correct, the blast furnace required approximately 371 cubic feet of burden and fuel for each day of operation. Since it was very costly to rebuild and restart the furnace, it would have been important to keep a surplus of both fuel and burden at the site to offset any kind of material disruptions. The estimated 371 cubic feet of material required an area approximately thirteen and a half feet by thirteen and a half feet piled two feet high. Thus, a month's supply of burden and fuel would have taken up most of the open area of the plateau. These supplies would probably have been placed in piles rather than spread out so that the plateau was completely covered with raw materials for the furnace, forge, and slitting mill. The present park-like environment is completely deceptive. In reality, this area would likely have been a grimy, industrial area reminiscent of the stock pile areas in modern ironworking facilities.

Overall Evaluation

To evaluate the overall project, one needs to return to the questions laid out at the very beginning of the chapter. Does the reconstructed Saugus Iron Works closely resemble the historic seventeenth-century ironworks? How accurately were the buildings reconstructed? The above discussion has, hopefully, shed some light on the way that major reconstructions succeed and fail.

Overall, the FIWA and the Reconstruction Committee did a very good job reconstructing the elements of the site that they chose to reconstruct. However, many of the buildings and features that were once an integral part of the ironworks have not been reconstructed or are being used in a way that does not reflect their historical usage. Reconstructing and incorporating these elements would provide visitors with a much more accurate view of the historic ironworks. The National Park Service, as owner and administrator of the site, should attempt to compensate for the missing buildings and features through interpretive programs or by undertaking additional reconstructions. Ideally, NPS would reconstruct the missing buildings and features although neither regulations nor budgeting would permit such an undertaking. Reconstructing the additional features would cost far more than the original expenditures to reconstruct the existing buildings. The current interpretive program has already been adapted to inform visitors on these issues.