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7.1 The Jenks site at the end of the blast furnace tailrace. (Photograph 2399 from the Roland W. Robbins slide collection, unknown date, Saugus Iron Works. Courtesy The Thoreau Society® Collections at the Thoreau Institute at Walden Woods.)

The Jenks Area and the Tailrace

Curtis White

Among the many "ingenious heads and hands" at Saugus was blacksmith/millwright Joseph Jenks. Like many other craftsmen and tradesmen of the period, his decision to leave England and cross the Atlantic was surely a difficult one to make. Once he settled at Hammersmith in the mid-1640s, Jenks remained there until his death. During his thirty-five-year tenure at Saugus, he witnessed the construction, operation, and demise of the ironworks itself. The manufacturing skills Jenks brought with him to New England were disseminated through generations of his descendants. As Jenks' manufacturing skills spread, the water-powered shop he built on the tail of the blast furnace faded into archeological remains, to be uncovered and celebrated by Roland Robbins in 1952.

Deserted site of Joseph Jenks' 1646 blacksmith forge being reclaimed by nature.

Prior to the start of archeological work at Saugus in 1948, Jenks was well known to local historians. An historic marker installed just above the site of the blast furnace in 1898 bore the title "THE FIRST IRON WORKS" and reported that "JOSEPH JENKS BUILT A FORGE HERE IN 1647 AND IN 1652 MADE THE DIES FOR THE FIRST SILVER MONEY COINED IN NEW ENGLAND." When the Massachusetts Tercentenary Commission commemorated the site in 1930, it erected a marker that claimed that Joseph Jenks had built a forge at the site in 1647 and had "invented the modern type of scythe." These pronouncements beg questions about Jenks' identity, his part in the development and growth of the ironworks, and what the archeology at Saugus revealed about him. What made Jenks, as Roland Robbins said near the end of his career, "the most exciting pioneer in America's industrial history I have ever met"?[1]

Roland Robbins, Miscellaneous Papers, 1977. The Roland Wells Robbins Collection in the Thoreau Society Collections at the Thoreau Institute at Walden Woods.

A rich collection of primary archival materials tells much of Joseph Jenks' story. Albert E. Jenks, a Jenks descendant and creator of the Department of Anthropology at the University of Minnesota, wrote to the York (Maine) Historical Society six months before his death in June 1953 to reveal that "I have 89 authentic documents which name him."[2] Albert Jenks' interest in Joseph Jenks kept him in regular contact with the First Iron Works Association from 1941 until his death. Between 1949 and November 1950, Roland Robbins corresponded with Albert, who provided a great deal of information about Joseph Jenks' time in America. At the time of the archeological excavations at Saugus, however, little was known about Jenks' life in England. It wouldn't be until Merideth B. Colket published *The Jenks Family of England* in the mid-1950s that the world learned of Joseph Jenks' English origins.

Joseph Jenks was born about August 1599 to John Jenks, cutler, and Sarah Fulwater, the daughter of Henry Fulwater, an immigrant German cutler. Joseph was baptized in the parish of St. Anne, Blackfriars, London, which was about an eighth of a mile southwest of St. Paul's Cathedral.[3] By his late twenties, Jenks had married Jone Hearn. In 1628, they had a son, Joseph Jenks, Junior, who was born in Colnbrook, Buckinghamshire, about fourteen miles west of St. Anne, Blackfriars.

About this time, in an effort to improve the English manufacture of swords, the government set up several German swordsmiths in a shop at Hounslow, about nine miles away from St. Anne. Swordmakers Henry Hoppie and Peter English wrote that

> in the yeare 1629 by reason of the warrs then in Germany the Artificers being disperst, Sr William Heydon, then employed in his late Ma[jesty']s Service in Holland designing to bring the Manufactorie of swordblademaking from thence, through much importunity persuaded severall of the workmen to come over into England, and his late Ma[jes]tie to encourage those artificers caused severall Mills to be erected at Hounslowheath for there use, where they made swordblades for his Ma[jes]ties stores and for the Gentryes wearing as good and as sharp as any in the world.[4]

[H]e hopeth by this meanes to raise upp more English to the same Trade, and that wee shall not have hereafter so much need of Strangers, wch wilbe a further benefitte to the Comon Wealth.

A swordsmith named Benjamin Stone built the Hounslow sword mill. In July 1636, Stone was granted a patent for military stores he made there:

> A spiall priviledge graunted to BENJAMIN STONE, swordblade maker, and his assignes for the terme of 14 yeares next ensuing, wthin England, Ireland, and Wales and town of Barwicke, to make and worke all maner of sword blades, fauchines, skeynes, rapier blades, and blasts serving as rests for muskets of any fashion or kinde whatsoever, according to a way and invencon, by him devised, by the helpe of mill or mills, and the same to sell at moderate rates–paying therefore yearelie to the Crowne Xls during the said terme; with the ordinary provisio for making this graunt voide in case it shall be found to be contrary to the lawe and inconvenient to the state.[5]

"The humble peticon of Joseph Jinks, sworde blade maker," Archives of the Duke of Northumberland at Alnwick Castle, England, 1639.

Jenks began working for Stone sometime in the 1630s. Whether Jenks worked directly in Stone's mill or forged blades in a separate shop and brought them to Stone for grinding is unclear. A single basket-hilted broadsword in the Powysland Museum in Welshpool, Wales, attests to Jenks' participation in this venture. On one side, the sword bears the inscription "IENCKES IOSEPH" and on the other side "ME FECIT HOVNSLO."[6]

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7.2 Detail of the ca. 1635 Joseph Jenkes sword. (Courtesy of the Powysland Museum, Welshpool, Powys, Wales, UK.)

By 1635, Jenks apparently lived on the eastern side of Isleworth Hundred, a 6,883-acre administrative division of Middlesex County, which lay west of London and was bordered on the east by the Thames River. The parish records for Isleworth contain the burial entries for his wife, Jone Jeankes, on February 29, 1634/35, and his daughter, [Eliza?]beth, on November 2, 1638.[7]

At the time, Isleworth Hundred consisted of four towns, Isleworth, Heston, Twickenham, and Hounslow, and a dozen villages. The Isleworth River winds through Isleworth Hundred from west to east, entering the Thames River at Isleworth. It powered a paper mill at Hounslow and a copper mill at Isleworth. The copper mill was built by "that famous Metallist, John Broad" between 1581 and 1587 for working copper and brass.[8] Broad claimed to have employed processes involving a rolling mill to make copper plates, a technique that had never before been used in England.[9]

Having gained swordsmithing skills working for Benjamin Stone, Joseph Jenks petitioned Algernon Percy, Lord High Admiral of England and the tenth Earl of Northumberland, to "graunt unto him a smale peece of worst ground . . . upon the [Isleworth] river at Worton Bridge . . . to sett up a smale shedd or workehouse" on August 7, 1639. On that small piece of ground, Jenks proposed to build "a new invented engine or blade mill." Jenks shrewdly pointed out that "there is never an Englishman in the kingdome that cann use that profession but himselfe (except the Dutch) and he hopeth by this meanes to raise upp more English to the same Trade, and that wee shall not have hereafter so much need of Strangers, wch wilbe a further benefit to the Comon Wealth."[10] It is not known whether Jenks ever built the mill at Worton Bridge and the prospects to excavate the site are dim as it is currently a large sewage treatment plant.

That yor peticonr is intended (wth yor Honors favour) to sett upp a new invented engine or blade mille upon the River, at Woorten Bridge.

"The humble peticon of Joseph Jinks, sworde blade maker," Archives of the Duke of Northumberland at Alnwick Castle, England, 1639.

In 1642, escalating tensions between King Charles I and Parliament erupted into civil war. The war would test the loyalties of all England's citizens in the early 1640s. Oliver Cromwell took control of parliamentarian forces and formed the New Model Army. This army changed the way future English armies would be formed. Unlike traditional military forces led by nobility and outfitted locally, the New Model Army promoted its most capable leaders and centralized management of its military stores. This centralization no doubt benefitted sword mills chosen to supply the army. Stone and his swordmakers Henry Hoppie and Peter English sided with King Charles and moved their operations to Oxford. Cromwell took control of Stone's mill in Hounslow and had it converted into a gunpowder mill.

One can only wonder if the deaths of Jenks' wife and daughter, the test of his loyalties as war developed, or the enticement of new opportunity led Jenks to leave for New England. He next appears in court records in the Kittery area of Maine, perhaps in relation to the construction or maintenance of saw mills. Unlike England, where hand sawyers opposed the construction of powered sawmills, forests in the New World were not depleted. New England proved very hospitable to such mills. [11] Forests offered vast

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7.3 Detail of Moses Glover's mid-1630s map of Isleworth Hundred during the period that Jenks was living there. All Saints Church, the Isleworth parish church, is in the lower left. Worton Bridge, where Jenks had petitioned to build a sword mill, is in the upper right. (Courtesy of Collections and Archives, Alnwick Castle, Northumberland, England.)

quantities of timber ready for the taking, but labor was in short supply. Water-powered sawmills were built in the 1630s to take advantage of the abundant timber resources and to compensate for the shortage of laborers.[12] These mills needed straight, sharp blades, which Jenks was capable of providing.

In May 1646, Joseph Jenks petitioned the Massachusetts General Court for the exclusive right to "Build a Mill for making of Sithes; and alsoe a new Invented Saw Mill, and divers other Engines for making of edge tooles." Once again, Jenks pursued a new business opportunity, this time in Lynn, Massachusetts. He told the court of his "knowledge in Making and erecting of Engines of Mills to goe by water for the speedy dispatch of much worke with few mens labour in litle time," clearly recognizing the importance of water-powered machinery in supplementing the sparse labor available in the new colony. Perhaps in anticipation of setting up a mill at the tail of the brand-new Saugus blast furnace, he asked that no other person be allowed to set up and use any such new invention or trade for fourteen years. The protection he requested was similar, he said, to "the usuall priveleg and liberty Granted by the high Court of Parliament in England to men that doe first sett upon workes of this nature." He argued for patent protection by further stating that he had "expended his estate, study, and labour, and have brought things to perfection; Another when he seeth it makes the like; and soe I loose the benefit of that I have studied for many yeeres before; which will tend to my Great damadg if not my utter undoeing." As he did in his petition to the Earl of Northumberland in 1639, Jenks set forth his willingness to "[i]mprove this talent for the public good and benefit and Service of this Country." Jenks' petition convinced the magistrates of his ability to implement his work; they granted his request while retaining the power to restrain the exportation of such manufactures if the situation required it. Jenks now saw himself "[i]ncoraged forthwith to sett on the worke."[13]

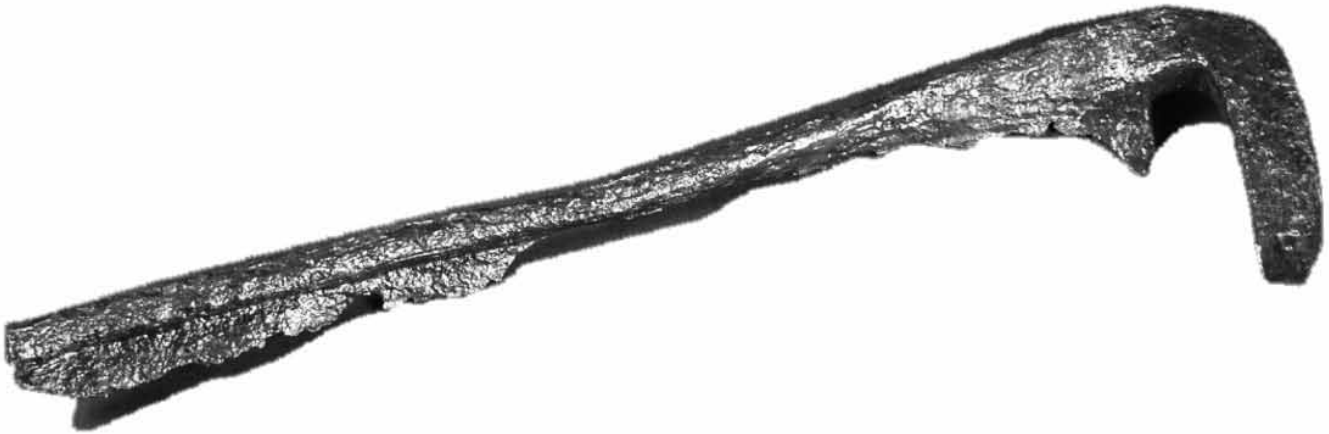
The Magistrates considering the necessity of raising such manufactures as are mentioned in the Pet[ition] and being sufficiently informed of the ability of the Petitioner to perform such works; doe conceive it fit (with relation to the Depties concurrence herin) that this Petition be granted, so far as concerns any newe such Inventions; and so far as it shalbe always in the power of this Court to restrain the exportation of such manufactures and the prizes of them to moderation if occasion so require.

"The Humble Petition of Joseph Jenkes, May 10, 1646," Massachusetts Archives, microfilm, manuscript, vol. 59, Manufacturers 1639-1773, 26.

A blacksmith on site at the Saugus Iron Works would be vital for the production of tools in high demand. Steel-edged axes and two-man felling saws supplied woodcutters with the implements to harvest the over 3,600 cords of wood fuel needed each year to run the ironworks.[14] Scythes provided farmers with sharp reaping tools needed for harvesting the grain that would feed the workers. On January 20, 1647, ironworks agent Richard Leader made an agreement with Joseph Jenks that allowed the millwright to

> have ye libertie to build & erect a mill or hamer for the forging and making of sithes or any other Iron ware by water at the taile of ye furnace & to have full benefit of the furnace water when the furnace goes provided he damnifie not any works that may hereafter be erected at the taile of the forge. [15]

In order to help Jenks start up his mill, the ironworks promised to "allow to the sd. Jenckes barr iron & cast iron for gudgins shafts & hookes for sd mill." In return, Jenks had to keep the mill in good repair and "p[er]fict ye sd mill by the 24th day June next." If he failed to meet those stipulations, the ironworks



7.4 Scythe blade (SAIR 2585) found at the Joseph Jenks site. In use, a ring held the tang (on the right) of the blade in its wooden handle or snath. A solid mass of iron formed the chine that strengthened the back of the blade. The thin web and edge have rusted away. (Photograph by Curtis White.)

could reenter the agreement, presumably with someone else.[16] Leader's 21-year agreement with Jenks was similar to the Massachusetts Bay Colony's agreement with the Company of Undertakers which protected the grantor's goals in case of failure. The ironworks ultimately wanted to secure a blacksmith; the company owned the shop and Jenks paid rent to the company to work in it.[17]

On first reading, the phrasing of Jenks' patent petition seems clear. A closer look, however, suggests that perhaps it wasn't. Jenks wished to "Build a Mill for making of Sithes; and alsoe a new Invented Saw Mill, and divers other Engines for making of edge tooles."[18] Since Jenks was a millwright, one would tend to think he had a new design for a mill to saw wood. Although Jenks clearly understood the mechanical technology, his "new Invented Saw Mill" actually may have been a mechanized way of making saw blades. When Richard Leader left the ironworks, he was building a sawmill near Piscattaway that reportedly would work "nere 20 sawes at once."[19] It is logical to assume that Jenks made the saw blades.

In the early 1650s, during the Hammersmith management term of John Gifford, Jenks continued to serve as the ironwork's blacksmith. As the length of the slag pile crept slowly past the east side of his shop, Jenks was paid for making four saws, two pairs of steelyards (graduated balances for weighing objects), and a "reste" to set saws.[20] Making saw blades required long, straight, and smooth pieces of iron. These iron blanks could be made in two different ways with the technology then in use at Saugus. One way involved beating pieces of iron under the hammer of a plate mill. This hammer would have to produce many blows quickly in order to take advantage of the heat in the thin pieces of iron before they cooled. The hammer marks would then be carefully ground out to produce the flat surface required for a saw blade to pass smoothly through the wood being milled. Iron finishers could also produce blanks by passing an iron bar through the rolling mill, getting the same results with less effort.

[Y]ou may put two or three or four saws at least up on the sam[e] fram[e], so far asunder as the thickness of the Boards which are to be sawn require . . . .

Isaak DeCaus, *New and Rare Inventions of Water Works,* p. 25.

Even when made with smooth iron, a blade could still become bound as it cut through a piece of wood. For this reason, the smith would set the teeth after cutting them into the blade.

> This Setting of the Teeth of the Saw is to make the Kerf [cut in the wood] wide enough for the Back to follow the Edge . . . . With the Saw-wrest . . . they set the Teeth of the Saw: That is, they put one of the Notches of the Wrest between the first two Teeth on the Blade of the Saw, and then turn the Handle Horizontally a little upon the Notch towards the end of the Saw; and that at once turns the Tooth somewhat towards you, and the second tooth from you: Then skipping two Teeth, they again put one end of the Notches of the Wrest between the third and fourth Teeth of the Blade of the Saw.[21]

7.5 This broken saw blade was made for a saw mill and found in ruins of the Jenks shop. An iron rod would have passed through the square hole to attach the blade to a sash that reciprocated with the help of a pitman arm attached to the waterwheel. Saw blades such as these could be ganged together to make multiple cuts with a single pass through the mill (Photograph by Dan Boivin.)

The smith continued the process until he set all of the teeth. Although it is not completely clear, Jenks' "New Invented" process of making saws may have been the use of the rolling mill to produce blanks or some mechanism for shearing the teeth from the blank.

The most definitive documentary evidence for Jenks' saw-making success comes from a letter written in late 1652, when former ironworks agent John Winthrop, Jr., was building a sawmill at the head of the Mystic River in Connecticut. Winthrop's uncle, Emmanuel Downing, wrote to him from his home in Salem: "When I understood that John Gallop was come to Boston, I went to the Iron Works, and told Goodman Jenks of the present opportunitye to send your sawes who told me he had tooe [two] ready which he would send you. I hope you have received [them] . . . ."[22] This letter clearly indicates that Jenks made saw blades not only for hand saws used in the ironworks but also for commercial, water-powered sawmills being set up throughout New England.

The future of Jenks and the ironworks became uncertain when the Company of Undertakers entered bankruptcy in the mid-1650s. As part of the settlement, the Company's part of the shop where Jenks worked, the rolling and slitting mill, and a corn mill located below Jenks' shop were awarded to local tailor and tavern keeper, Joseph Armitage, as compensation for debts due to him. On September 12, 1656, Jenks purchased Armitage's share of the shop and corn mill and on October 27 he purchased the rolling and slitting mill with all the appurtenances.[23] To pay for his newly acquired properties, Jenks secured a mortgage from future Massachusetts Bay Colony governor Simon Bradstreet of Andover. In addition, Jenks mortgaged his dwelling house and a nearby house lot. After two initial payments, Jenks was to pay in "good English Commodities bar Iron or Nayles at prices current" in six-month increments over the course of four years until the mortgage was "fully satisfied."[24]

Large saw found resting on top of 2nd wheel pit's top west sill. Was directly east of plumb blocks. Handle end was south and the teeth were to east side.

Robbins artifact note card, SAIR 1004, April 12, 1952.

In May 1666, Jenks used his expertise in mill construction to help inventory the estate of Lynn miller John Farrington. Farrington's corn mill included a water mill, dam, floodgates, and a mill house. The mill operation, valued at £190, was separated from the rest of Farrington's estate because he and his brother Edmund owned the mill jointly.[25]

In October 1667, Jenks once again sought to apply waterpower to start a new entrepreneurial venture: the production of wire. Just a little more than a year after the Great Fire of London destroyed the St. Anne, Blackfriars, church where Jenks was baptized, he was "not only weakened through age and some of the infirmities thereof but also very weak in estate." He petitioned the General Court once again, this time for £50 for a workroom and a stock of coals and iron to make wire. Iron wire, he said, was "much wanting at this day to the help of the country in spinning to make cloth of all sorts of wool as also for making hooks for the supply and furtherance of the trade of fishing and all other trades that has any dependence on or necessity of wire for its completion." This "poor petitioner" presented his "humble ser-

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7.6 A downspout carried excess water around the excavation site of Jenks' blacksmith shop. The shop included overshot and undershot waterwheels with their wooden hutches, vertical supports for a tail-helve hammer, a wooden anvil base, a stone forge, and wooden floor boards. (Photograph 1356 from the Roland W. Robbins slide collection,1952, Saugus Iron Works. Courtesy The Thoreau Society® Collections at the Thoreau Institute at Walden Woods.)

vice and readiness to this work as his desire to promote the general good of this Country, while he lives as a member thereof." The location of his blacksmith shop at the tailrace of the blast furnace, Jenks argued, made him "more capable in respect of a convenient place in respect of water for the easier affecting of the work with the lesser charge both of purse and hands than any other that does now present."[26]

To produce or draw wire, the desired metal is hammered into a round rod and annealed. Almost any metal can be used. Gold, silver, iron, copper, and brass were most commonly used in the seventeenth-century. Annealing softens the metal so it can be easily pulled through a steel draw plate. The annealing process varies depending upon the metal used. In the case of brass, the metal is slowly heated to a red color and plunged directly into water. To anneal iron, the iron is heated to an orange color and then cooled very slowly. Annealing needs to be repeated during the wire-drawing process because the greased or waxed metal becomes work-hardened and brittle as it is pulled through the draw plate. The plates

> are half palmo long with several rows of holes of successive sizes. In addition, a pair of large tongs with flat, serrated mouths and open legs are needed. These should be held by a stirrup-shaped iron ring which has a hook at the foot to which is attached the end of a belt or rope, the rest of which is wrapped around the small windlass or the large one by turning. In this way the tongs close when you pull them . . . . Then by turning the levers of these instruments with the force of men, the little bars of the said metals are pulled and caused to pass through all the holes of the drawplate one by one.[27]

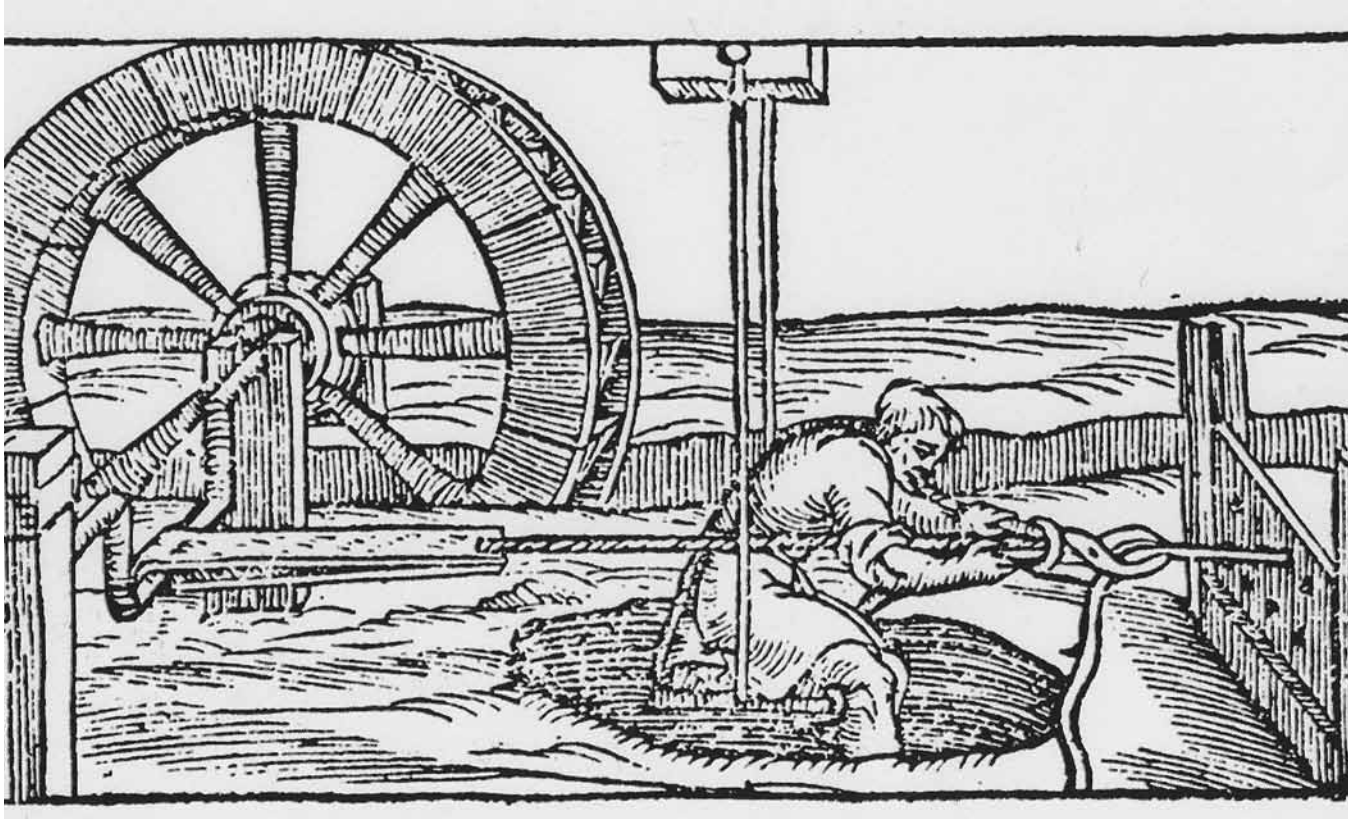
Letting the water run the wheel, the man, who has tied the band in the middle of the bent axle, lets himself be drawn backward and then pushes forward. His only care is to seize with the jaws of the tongs the end of the wire that issues from the drawplate with every return that he makes.

The Pirotechnia of Vannochio Biringuccio, p. 381.

Soft metals such as gold, silver, and brass could be pulled through the draw plate with manually powered windlass machines, but iron required more force such as that provided by water power.

> The finding of "the commite" that judged Jenks petition is not clear. At the bottom of his petition, someone added "The committe se not sufficint grounds to Incoridge the Country to adventure an Estate on ye design: yet finding ye Petitioner desirous of fifty Pounds to enable him to the worke we shall leave it with ye honored court if they se reson so for to advance upon it."[28]

By 1678, the ironworks no longer produced iron and had begun a steady decline. Local inhabitants petitioned the Massachusetts Bay Colony for permission to remove the ironworks dam.[29] At the same time, Samuel Appleton, Jr., and Thomas Savage were in dispute regarding ownership of the ironworks. Appleton had the "great furnace bellows" dismantled. Jenks and his 17-year-old son, John, had apparently been at the Jenks shop just below the furnace in time to witness the removal of eight bolts and a bellows pipe. The Jenkses testified that the bolts "cost the proprietors of the works at Hamersmith five pence pr pound" and that the bellows pipe "cost thirty shillings when new." Jenks' knowledge of the cost of these



7.7 This sixteenth-century woodcut illustrates a water-powered wire-drawing operation similar to what may have been in the Jenks shop to draw wire. (From *The Pirotechnia of Vannoccia Biringuccio,* p. 380. Courtesy Dover Publications)

materials suggests that he may have made them himself for the ironworks.[30] Finally, in May 1682, after three attempts, the great dam that held back the water that supplied power to the old ironworks was destroyed.[31] The canal that had supplied the furnace may have still provided power to Jenks' shop. Less than a year later, in March 1683, Joseph Jenks died.[32]

After Joseph's death, ownership and operation of the Jenks blacksmith shop becomes unclear. Joseph Jenks, Jr., had come to Massachusetts, probably in the early 1640s, and established an ironworks in Concord, Massachusetts. By the end of the 1660s he had founded an ironworks and sawmill in Pawtucket, Rhode Island.[33] After immigrating to New England Joseph Jenks, Sr., had married a second time and had three more sons: Samuel in 1654, John in 1660, and Daniel in 1663. Daniel built mills in Cumberland, Massachusetts. At least three more Jenks progeny were blacksmiths in Lynn: son Samuel and grandsons John and Samuel, Jr. Samuel Jenks, Jr., died on March 16, 1745, and was buried in the Old Burial Ground in Saugus Center.[34]

Two hundred sixty-five years after the death of Joseph Jenks, Sr., Roland Robbins' began work at the ironworks and encountered the Massachusetts tercentenary sign that implied that Joseph Jenks had built the Saugus Iron Works. While Robbins knew of Jenks' involvement with the ironworks from the start of the Saugus excavations in 1948, he did not begin to explore the Jenks site until 1952.

On September 10, 1948, Robbins met blacksmith Edward Guy, who had been part of early efforts to preserve the Iron Works House (see Chapter 3). Prior to his purchase of the house, preservationist Wallace Nutting hired Guy to make reproduction hardware for the restoration. Nutting's work crew added a six-room cottage onto the back of the restored house where Guy would live with his family. Working first out of an old chicken coop, Guy later disassembled his old shop in Newburyport, had it shipped to Saugus, and built a new shop from the salvaged lumber. He attached the chicken coop for additional space. From this shop, Guy contributed his classical blacksmithing skills to the Colonial Revival era by making quality reproduction hardware for sale through Nutting's catalog.[35]

Despite a falling out with Nutting, Guy continued to live and work at the site and continued to work in his shop as the property changed hands twice. He still was there 34 years later when Robbins began his "work of locating the original site of the blast furnace erected in 1643 (or there abouts) by Joseph Jenks." After being introduced to the site by First Iron Works Association president J. Sanger Atwill, Robbins talked to Guy about his knowledge of the site. Guy recalled that "when he came to his shop a John Patcher, then some 80 years of age, told him that when he, Patcher, was a very little boy, he remembered the older boys playing in the ruins of the old Jenk's mill. Later these ruins were torn down (while Patcher was still a small lad.) Mr. Guy pointed out signs of the original Jenk's mill as pointed out to him by Mr. Patcher." According to Robbins' maps documenting the next few days' work, it appears that Patcher

Mr. Robbins was it? Came there, came in the shop and asked if we knew where the original foundry would be. Well we walked across the street to the cinder bank and my father said look there's the slag here. Where would they haul the slag to or from? The foundry. So, naturally we followed that . . . . And my father says well I presume it was down in this hollow. . . . And they dug there. And right where my father suggested was the forge [furnace] they found the blowpipe . . . . The original blowpipe! By gosh you hit it right on the nail!

NPS Interview with Edward Guy's son, Edward L. Guy, June 6, 1974.

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7.8 Blacksmith Edward Guy working in his shop. The building would soon house the site's archeological collections. Robbins took this photograph through an open window on September 1, 1949. (Photograph 123 from the Roland W. Robbins slide collection, 1949, Saugus Iron Works. Courtesy The Thoreau Society® Collections at the Thoreau Institute at Walden Woods.)

had actually pointed out the site of the blast furnace.[36] Robbins believed that the blast furnace was part of the Jenks operation until he received a letter from Albert Jenks dated March 11, 1949. Albert Jenks made Robbins aware of the September 12, 1656, purchase by Joseph Jenks of a "corne mill and forge situated at the taille of the forge and furnace."[37] Robbins would not discover the Jenks shop for almost another three years.

During the week of February 10, 1952, Robbins' crew began to explore the area between the west side of the slag pile and the east side of the Central Street retaining wall, using freshly sharpened grub hoes. Metal stakes were cut and driven into the ground at strategic locations. The stakes, numbered one through seven, were benchmarks to help document any findings along the furnace tailrace that had come to be known as the Jenks area. On Valentine's Day, a bulldozer pushed back the southerly end of the slag pile almost ten feet to extend the road and dam from the wharf excavation area to just south of the Jenks area. The road was patched and filled with gravel so that dump trucks could remove excavated fill from the site. Robbins began to excavate from the river northward toward the blast furnace. Work progressed all week, with crane operator Roy Bacon removing large quantities of fill with his "clam shell" as Robbins' men worked with hand tools. Sixty-four inches below the surface, the men found two "base sills" among other timbers and rubble. Robbins speculated that the sills, which lay forty inches apart, were part of either a race or wheel pit.[38]

I had Charlie cut me 7 stakes. I had them driven at various places along both sides of Jenk's activity on tail of furnace. They shall be numbered and will be used for bench marks to locate relics found during future excavations in this area.

Roland Robbins, "Saugus Ironworks Daily Log - 1952, February 13, 1952.

On Friday, February 15, Robbins called in photographer Richard Merrill to take pictures of the Jenks area before heavy earth removal took place to uncover the sills. Surveyor John Bradford was also called to take elevations of the sills but was unable to do so because of the cold weather. A crew member took the elevations instead, noting that the top surfaces of the timbers lay at a depth of nine-and-a-quarter-feet. Robbins noted that the "sill is about 3" to 5" below average high tide . . . . [I]f this evidence is a race, or wheel pit, or leads to the same, it will be quite evident that there has been a land recession, or tidal change—or both—during the past three centuries."

Robbins made the next big discovery related to the Jenks area late in the afternoon on February 20, 1952, when he uncovered "the hub and a section of the shaft of a waterwheel." Based on the evidence he had found to date, Robbins believed this was the right size and place for a waterwheel, although he didn't think the shaft was in its original position. "It is too early to tell, but this may be some of Jenks' 'engine to go by water,' for which the first patent in America was issued." The next day, as excavations continued, historian Hartley stopped by to see the hub and shaft. He believed the hub had paddles in the mortises rather than spokes. Perhaps because Jenks at one time owned the slitting mill, Hartley also believed the slitting mill may have been located in the Jenks area. Later the same day, Merrill photographed the shaft ***in situ*** and then the shaft was plotted and removed. Robbins notes that he wrapped it in a blanket and suspended it by rope above the bottom of a test trench filled with water.[39]

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7.9 The end of the slag pile cut off and spread out to provide a service road for Jenks area excavation vehicles, February 14, 1952. (Photograph 1204 from the Roland W. Robbins slide collection,1952, Saugus Iron Works. Courtesy The Thoreau Society® Collections at the Thoreau Institute at Walden Woods.)

A week later Robbins reports finding many more timbers along with "an abundance of artifacts," among them an "excellent, ancient iron axe." On Friday, February 29, 1952, Robbins writes, "At 1:45 p.m. I located a section of a waterwheel shroud, spoke, and sole resting in what may prove to be its wheel pit. This is in Jenk's [sic] area." Atwill was on the site when the spoke was found and in the afternoon Robbins called Hartley about the exciting find and made arrangements for him to visit the site the following morning.[40]

The next day, Robbins and Hartley looked over the wood evidence that Robbins had uncovered the previous day. After lunch, they checked the deeds concerning the area. At about two in the afternoon, Robbins found another wheel spoke just a few feet north of the one found on the day before. At that point,

> Hartley changed into rubber boots and sweaters and helped me clean it off. It's [sic] design (what could be seen) is somewhat similar to the furnace waterwheel. It is quite different than the spoke, sole, and shroud found south of it. It appears as though I have found the remains of two waterwheels in their wheel pits, and close together. I doubt the hub and its spoke, found February 20th, has any connection with the two wheels just found. It appears likely that a series of waterwheels existed here—maybe they all utilized the same wheel pit. Hartley is amazed with the developments here.[41]

Hartley is amazed with developments here. Believes this may be the site of the Forge the Iron Works are known to have had. If so, then Jenks' concessions must be south of this.

Hartley, Robbins continues, "believes this may be the site of the Forge the Iron Works are known to have had. If so, then Jenks' concessions must be south of this."[42]

Roland Robbins, "Saugus Ironworks Daily Log - 1952," March 1, 1952.

During the first week of March, excavations continued at the Jenks area on the northern and southern ends of the site. Robbins made arrangements for the removed fill to be brought to the Anna Parker Playground on Essex Street, Saugus. Architect Conover Fitch introduced his colleague Herb Bogen to Robbins on March 6. The next day, Bogen made his first drawings of the Jenks shop waterwheel finds. Surveyor John Bradford measured the waterwheel components and documented their elevations and Robbins, for the first time, began using the term "first wheel" for the northern wheel and "second wheel" for the southern wheel to indicate the order in which the wheels were situated on the blast furnace tailrace. Robbins writes in his notes that Hartley visited the site again and "feels convinced that the evidence I am uncovering in Jenks' area, particularly the first wheel and large timbers handy by, are not Jenks' works but belonged to the Undertakers."[43] By early May 1952, Hartley would change his opinion regarding this area.

On March 18, 1952, Robbins began to find large numbers of brass sewing pins, mostly on the east side of the waterwheel sluiceways from the first wheel all the way down to the third wheel pit, even underneath the sluiceways.[44] These pins may confirm that Jenks drew wire at the site. To make such pins, a

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7.10 Looking westward, the remains of Jenks' overshot waterwheel shows signs of extended use, May 16, 1952. A cast-iron boit in the background supported the shaft and water-wheel that provided power to a tail-helve hammer. (Photograph 1483 from the Roland Robbins slide collection, 1952, Saugus Iron Works. Courtesy The Thoreau Society® Collections at the Thoreau Institute at Walden Woods.)

blacksmith would first have to form the pin shank from a short section of wire. He would then anneal a smaller gauge wire and wrap it around a wire the same gauge as the pin shank. This created a long coil that looked very much like a spring. Two revolutions of the coil were cut off as a single piece and slid over what would become the head end of the pin. The head was formed into a ball by placing the coiled-wrapped end of the pin into a precisely made forming die. These dies had small, semi-spherical cavities and pressed the coils around the shank in a manner similar to forming a snowball between two cupped hands.[45] Many times, pins were coated with tin, which soldered the heads fast and provided a protective coating. The pins were then polished to harden them for greater durability.

Given the precision required to make pins, it seems unlikely that Jenks, by then in his sixties, would have had the dexterity and eyesight to do this fine work. Perhaps Jenks drew the wire and built the machinery to produce the pins and a younger member of his family actually made the pins. Typically, women and children made pins. Large iron fishhooks were also found at the ironworks site. Unfortunately, Robbins did not document where they were found. In any case, archeology at Saugus seems to reinforce the seventeenth-century documentation. Both brass and iron wire were drawn by Jenks' machinery built in the tailrace of the blast furnace.

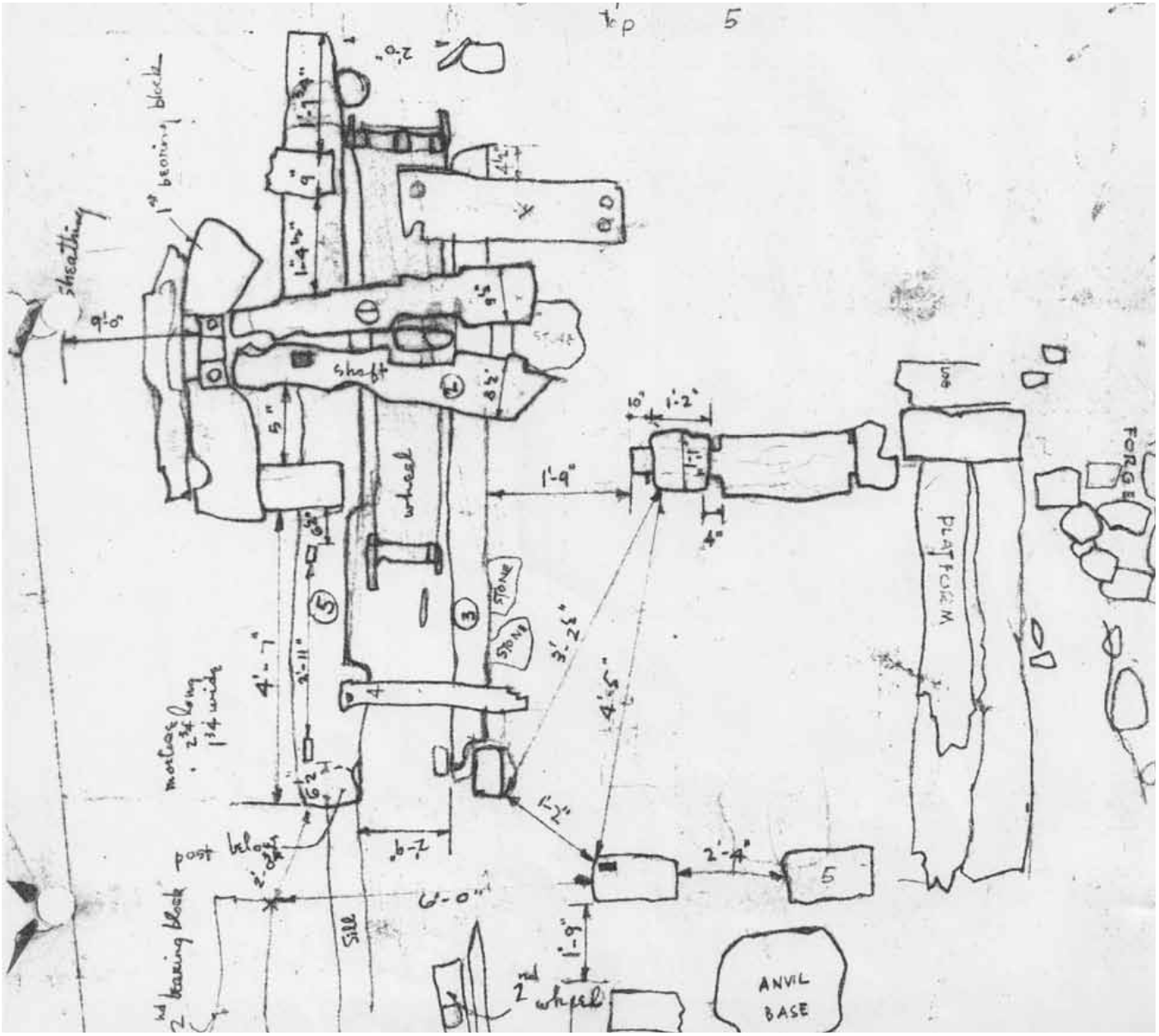
Bradford here this A.M. and plotted and took el[evations] of timbers and wheel pit sills along furnace tailrace excavations, etc. Hepburn here this A.M. with Fitch and Bogen. Fitch and Bogen stayed for the day. In P.M. they did considerable measuring of timbers, sills, plumb blocks, etc. on the furnace tailrace.

Roland Robbins, "Saugus Ironworks Daily Log - 1952," March 26, 1952.

In early March 1952, Robbins was introduced to renowned Harvard paleontologist Percy Raymond. Although Raymond had made a name for himself identifying fossil species and their relationships within stratigraphic zones, in his retirement he had become an expert on colonial pewter and spoons.[46] In mid-March, Raymond commented on a number of spoons that had been discovered at Saugus. Two seal-top spoons had been found just south of the blast furnace near the tailrace. Based on their shape and touch marks, Raymond estimated that the spoons dated to about 1660. The first spoon, found during the 1949 excavations, had an elliptical bowl and was marked with a Tudor rose; Raymond dated it to 1680–1690. He identified another spoon, found on the furnace tailrace at the Jenks shop, as a French slip-top spoon dating to about 1660.

Hartley researched the "goldish" material that comprised the spoons and pins and reported to Robbins that it was brass with considerable lead. Robbins called Raymond, who now thought his original dates had been conservative and that the spoons were much older than he had originally suggested.[47] Because the First Iron Works Association called a halt to research on the Jenks site in mid-April 1952, many questions remain regarding spoons, spurs, and other brass objects found there. Where did the brass come from? Did Jenks recycle brass to make wire? Did he cast other brass implements? Future study of maker's marks on these spoons and of the composition of the brass may suggest answers.

Robbins and his crew continued to systematically dig, measure, draw, photograph, and remove the timbers and machinery of the Jenks site. On April 10, Robbins ordered 500 numbered fiber tags that he



7.11 Detail of drawing of Jenks' hammer assembly including: an overshot waterwheel and shaft, hutch, bearing block, fulcrum (as Robbins called it)and anvil base. Forge and floorboards can be seen on the right. (Perry, Shaw and Hepburn, Kehoe and Dean drawing, March 26, 1952.)

would use to "number wood evidence removed in the future."[48] Until this time Robbins had used raised-numbered tacks like those used to label railroad ties or storm windows.

Excavations continued on the southwest and west sides of what Robbins referred to as Jenks' third wheel pit. The artifacts discovered there include a cannon ball, a metal slab with holes through it, many pins, a metal weight with a ring through it, and a thirty-three-and-three-quarter-inch wrought-iron tuyere, or bellows pipe, in excellent condition. Two spoons were also found.[49]

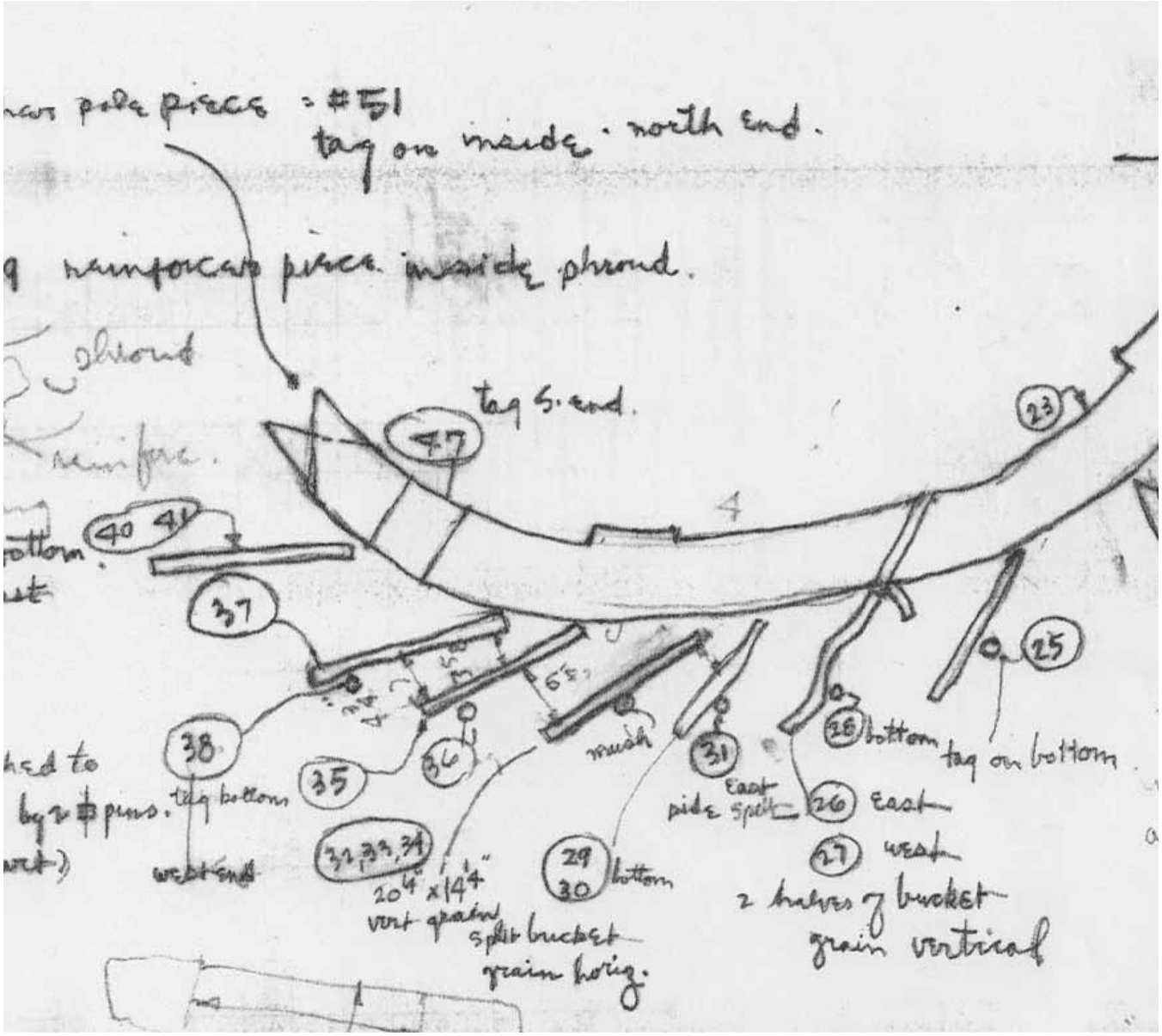
On April 12, Robbins had at least four men clean out the second and third wheel pits, which enabled him to locate the floor and sheathing of the second wheel pit. Robbins himself cleaned the tuyere he had found and was very happy with the finished product. He made one of his most significant finds, a broken saw blade about two feet long, on the west side of the second wheel pit, lying on the top sill. He labeled the saw blade with an index card that carefully mapped its location and north-south orientation.[50] A square hole at the top of the blade indicates that it was meant to be installed in a sash frame and held in place with a square-shank bolt. This technique for attaching a saw blade to a reciprocating sash is shown in an illustration of sawmill construction in a book on waterworks published in London in 1659.[51] It is the same type of blade that would likely have been used in Richard Leader's Great Works in Maine and the Connecticut mill of John Winthrop, Jr.

I reviewed work of furnace, casting beds, etc., excavations with Bogen. In P.M. we dismantled part of 1st wheel on furnace tailrace.

Roland Robbins, "Saugus Ironworks Daily Log - 1952," April 14, 1952.

About a month after Robbins submitted a four-page report to Quincy Bent about the finds at the Jenks site, Atwill received a letter from Bent intended to redirect the focus of archeological excavations. His letter dated April 18 reads in part:

> Our work at Saugus should be quite definite:
>
> 1. To restore the complete blast furnace unit.
>
> 2. To plan for the restoration of the forge-finery, slitting mill and wharf.
>
> I regard the Jenks' area finds interesting, but not too important as to our main objectives. Someday we might want to complete the whole job, but now our attention must be focused on the main works restoration.
>
> I am sending a copy of this letter to Robbins, Fitch, and Hartley, so there ought not to be any misunderstanding as to our main objective.[52]



7.12 Jenks hammer wheel showing the location of the fiber tags that Robbins applied to individual wooden parts. (Perry, Shaw, and Hepburn, Kehoe and Dean drawing, May 15 and 16, 1952.)

Shortly after receiving this notice to redirect excavations on April 30, 1952, Robbins' crew discovered a die, a long tool with the initials stamped in reverse on the face. A blacksmith would use such a tool to stamp his maker's mark into his finished work to identify himself. The finished piece was typically cold when stamped and the tool would have probably been made of steel to resist deformation. When a maker's mark was imprinted on any surface of silver, gold, pewter, or iron, it was done using this common technology. In fact, a similar die was used on silver blanks to make the New England Shilling in 1652. "It looked like a chisel," writes Robbins about the tool. "However, on close examination I noted the initials W.C. Phoned Neal."[53] Hartley had some immediate ideas but followed up with more research and replied to Robbins in a letter dated May 14. "I've done some checking in the meanwhile and my first impulse seems to have been confirmed in a way which I think you will find interesting. William Curtis was Joseph Jenks' apprentice, living with him, and eventually became, apparently, a highly skilled toolmaking smith. Somewhere along about 1657–1658 he wrote to young Winthrop offering to go to work for him at the Connecticut ironworks. The letter is rather cute." Transposed into modern English it reads:

> Master John Winthrop, I remember my loving service to you hoping you are in good health as I am at this present and will be your smith, if you please, to make all your iron ware which belongs to forge or furnace, and I know there is none that can do it so well as they that are used to it, and to make all sorts of ware that the Country has need both for Englishmen and Indians and I hope to be profitable for you and I rest you as your loving friend.[54]

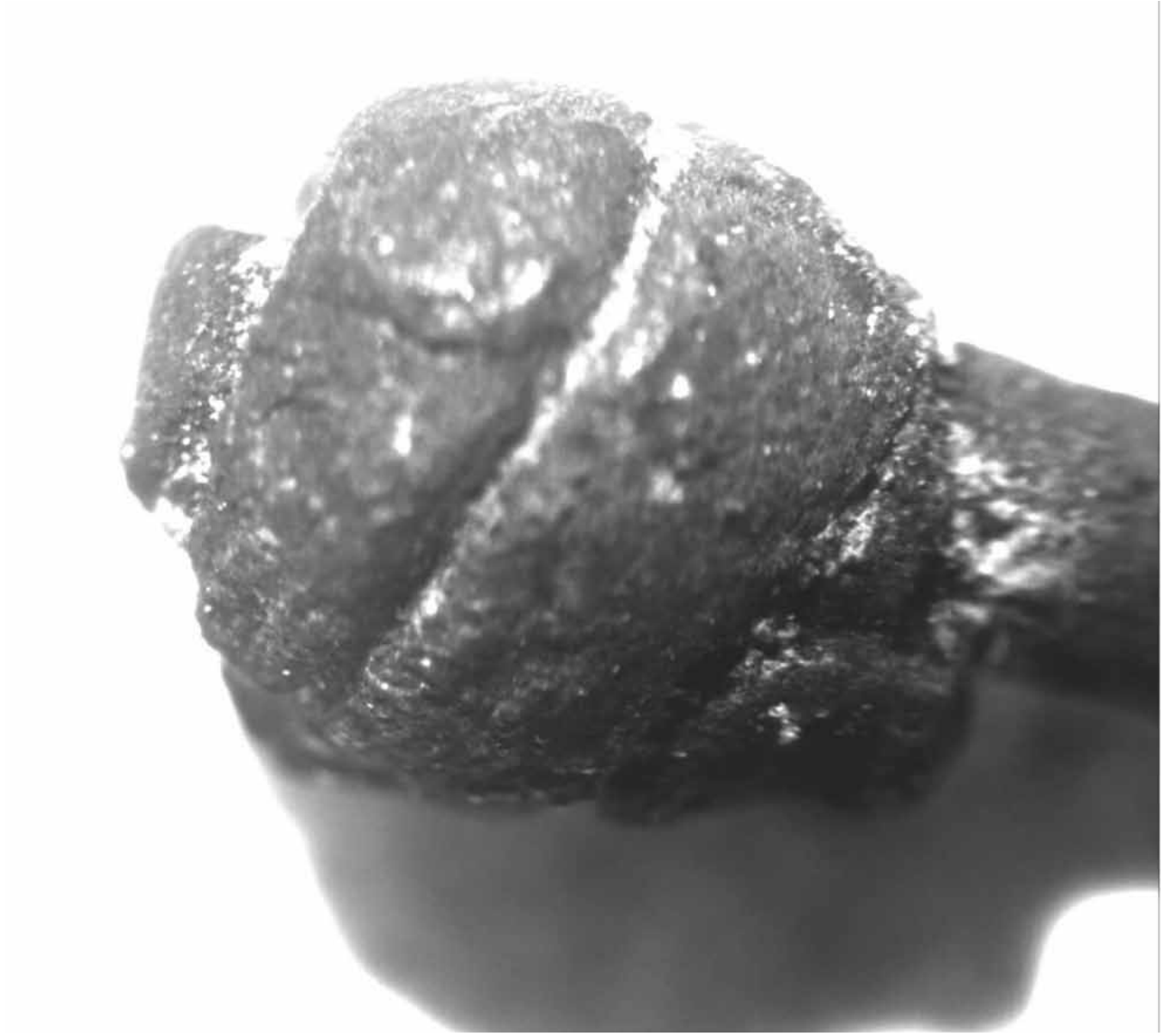
Hartley continues, "It carries the designation 'living with Joseph Jenks' and was endorsed by Winthrop 'William Curtis forge smith.'" Another letter, from John Francis to Winthrop, reveals "that Curtis had been Jenks' apprentice." Still another letter, from John Vinton, provides further evidence "Also here is a young man named William Curtis, a smith, one that wrought with Joseph Jenks senior, which will be beneficial to your works."[55]

Hartley's final comment reveals his and Robbins' disappointment regarding the decision to suspend work at the Jenks site. Hartley concludes his letter to Robbins by stating, "All of which suggests to me that short of the initials 'JJ' [Joseph Jenks] this 'WC' was the best thing you could hope to find in the digging area that Q.B. [Quincy Bent] tends to regard as secondary."[56] Hartley was finally convinced of the location of the Jenks shop, and so too was Quincy Bent.

Almost immediately after Robbins received his copy of Bent's letter, exploratory excavations of the Jenks shop ceased and became a mission of recovery and preservation. For the next few months, retrieval

[Of] the trade of the pin-maker; a workman not educated to this business . . . , nor acquainted with the use of the machinery employed in it . . . , could scarce, perhaps, with his utmost industry, make one pin in a day.

Adam Smith, *The Wealth of Nations, http://www.econlib.org/library/Smith/smWN1.html#I.1.3* (Accessed November 8, 2009.)



7.13 Microscopic view of a small brass pin from Jenks area. A small gauge wire was wrapped around a larger gauge wire and forged with hemispherical dies into a small ball. (Photograph by Curtis White.)

of large and small Jenks timbers, anvil base, waterwheels and artifacts continued. Robbins shifted his exploratory work to the forge but always remained fascinated with the Joseph Jenks story.

Since his discovery of the Jenks shop in 1952, Robbins had been frustrated that nobody seemed to care. He visited the Iron Works in July 1966 while giving a tour to students from the University of New Hampshire. While there, he photographed the Jenks site and labeled it, "Deserted site of Joseph Jenks' 1646 blacksmith forge being reclaimed by nature." Later, in a red three-ring binder, Robbins collected many photographs of the Jenks excavations and introduced them with a short, typewritten account. Dated May 11, 1977, and written on his personal letterhead, the account read in part, "Through all of this my greatest satisfaction and inspiration was derived from the excavations of the site of Joseph Jenks' Blacksmith Forge, for which he received America's first patent in 1646 for 'Engins of mils to go by water for speedy dispatch of much worke with few hands –'". It appears that Robbins had written this with "posterity" as the intended audience, to keep interest in the Jenks story alive. Even after Robbins' death, at a dedication of the Samuel Parris parsonage site in Danvers, Robbins' widow expressed "Rolie's" disappointment that the Jenks shop was never reconstructed.

Robbins' excavations of the Jenks shop provide valuable confirmation and clarification to the Joseph Jenks story. He took over 200 photographs of the excavations as they progressed. Over forty measured drawings document each piece of machinery as it was removed from the ground between March 7 and June 3, 1952. Combined with the documentary evidence available today, the archeological evidence unearthed by Robbins continues to provide a rare glimpse at the transfer of technology from England to New England in the mid-seventeenth century.