Society for Industrial Archeology · New England Chapters

Volume 45 Number 2 2024

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Richard Coughlin, Ron Klodenski, Sara E. Wermiel

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David Coughlin, Second Vice President
Richard Coughlin, Treasurer

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SAVE THE DATE!

The 36th annual SIA conference will be held April 26, 2025 at the Attleboro Industrial Museum. Stay tuned for further information and a call for papers.

NNEC President's Report

David J. Dunning

This fall's virtual tour will be of the Cog Railway up Mt. Washington. It will consist of 18 pages with 28 photos explaining the design, construction and operation of this landmark project. The link will be sent out by early December.

The 2023 annual meeting wasn't held last fall, due to that first virtual tour. So, it was held this summer over lunch at the spring tour. As usual, no one was nominated or volunteered for any of the elected offices. That first virtual tour was discussed, and it was agreed to continue having them once a year, if we don't come up with a second actual tour.

The SNEC also has no volunteers to fill the top leadership positions. Betsey Dyer was asked to tell us, at our meeting, how they are getting by. She explained that while few people can commit to the responsibility of being president or vice president, more are willing to volunteer for specific projects. Those projects have termination times, so the volunteers aren't locked in for a term of office. President Dunning suggested that the NNEC may have to consider that, some year, if no one is willing to take over our president's role (which he has held for over 15 years now).

NNEC Treasurer's Report

Richard Coughlin

Bank balance on September 30, 2024: $3,022.
Bank balance on September 30, 2023: $2,763.
The bank balance has increased $259 this year due to generous contributions from several of our members.

The annual *paid* membership as of September 30 is 25. *Life* membership is estimated at 25-30. Annual membership dues of $20/yr. paid by 25 members = $500. This is not enough to cover the cost of the printed newsletter twice a year ($588 and $510 in the past year = $1098). We also pay $156 for our share of the New England Chapter's website. Total annual costs: $1254.

We are most thankful for member contributions as they provide funds to continue printing the newsletter twice a year and offset the costs of hosting the SIA conference.

As we contribute to paying for the New England Chapter's website, I recommend visiting it at nec-sia.org. It is full of information about New England historical sites and histories, articles from the SIA conferences, information on past SIA events and tours, plus over 80 SIA newsletters going back to 1980. Check it out!

Robert Chevalier Stewart, Jr.

OBITUARY

Robert Chevalier Stewart, Jr., of West Suffield, Conn., and a past leader in the SNEC, passed away suddenly on Oct. 3, 2024.

Born on Dec. 11, 1933, in Quincy, Mass., Bob grew up in Everett, Mass., and finished his senior year at Newton High after his family relocated. At Northeastern University, Bob majored in biology and chemistry. He also became a filmmaker, shooting an Army ROTC recruiting film. Bob joined the Army Signal Corps after college, serving as company XO among other responsibilities, training in aerial surveillance, and flying the first generation of drones.

Bob worked as an engineer at United Technologies for three decades, where his final business card listed him as "Wizard." He held eight U.S. and worldwide patents in the fields of industrial brazing, purifying gas streams, and fuel cell technologies.

After retiring from UT, Bob went back to school and received a degree in industrial archaeology and anthropology from Central Connecticut State University. In his sixties, Bob started Historical Technologies, a consulting firm that did archaeological excavations and recording at industrial sites around the country. He will be missed.

SNEC-SIA Treasurer's Report

Sara Wermiel, SNEC-SIA Treasurer/Registrar & Management Committee Convener

The Southern New England Chapter organized two tours in 2024. In April, David Moore, chair of the Bridgewater Historical Commission, arranged for a tour of the long-lived Henry Perkins Co., a foundry in Bridgewater, Mass. This process tour was followed by a visit to the site of the former Bridgewater Iron Co., now a public park. Dave's article on the history of iron manufacturing in Bridgewater can be found in two previous newsletters (part 1, vol 44:2, part 2 vol 45:1). Then in June, keeping with an iron manufacturing theme, SNEC toured the site of a colonial-era iron works in Saugus, Mass. Led by National Park Service rangers (the site today is Saugus Iron Works National Historic Site), the tour covered how this place came to be a historical site and its archaeological excavation and reconstruction, as well as iron making there when it was in operation in the 17th century.

SNEC would like to offer more tours and welcomes proposals for tours and programs. Betsey Dyer is handling tour, program, and conference ideas. If you would like to suggest a tour or IA activity, please contact Betsey, bdyer@wheatonma.edu.

On April 26, 2025, SNEC will host the annual New England Conference on Industrial Archeology at Attleboro Industrial Museum, Attleboro, Mass. It's not too early to be thinking of a topic you'd like to present at the conference. We also would like ideas for exhibits at the conference. We will be putting out a call for presenters and exhibitors early next year, but if you already have an idea for a topic you'd like to present at the conference, please send it to Betsey Dyer (email above).

SNEC has been working with the Charles River Museum of Industry and Innovation to find people who can give presentations, or lead panels, on IA topics at the museum. If you have a topic you would like to present or an idea for a panel, please send it to Betsey Dyer (email above). Proposals will be evaluated by the SNEC Management Committee and forwarded to the museum director for consideration.

NNEC Spring Tour Report

David J. Dunning

On Saturday, July 20, about 25 interested members from both chapters met in Hartland, VT. Our host and tour guide for the day was Jay Boeri, a mechanical engineer who specializes in hydro-power. We met at the dual generating station that he designed and had built there, between 1984 and 1986, Martinsville Hydroelectric. Martinsville once had many mills of all types along Lull Brook, which flowed into a gorge. Jay's generating station now links nine former water powered mill sites that had operated for 165 years along 800 feet of Lull Brook's Mill Gorge.

built in the United States. It is recognized by the American Society of Civil Engineers as an engineering landmark and is listed on the National Register of Historic Places. The Ascutney Mill Dam is among the very earliest masonry dams of significant size. Made of granite, the dam is the structural precursor of today's concrete gravity dams.

Ithamar A. Beard, an engineer of some prominence in New England, surveyed the mill brook and selected the best site for a storage dam. Contractor Simeon Cobb, knowledgeable of contemporary civil engineering practices, made major changes to the dam's original design, converting the linear dam into a gentle arch.

(photo David J. Dunning)

Portion of the inlet pipe at Martinsville Hydroelectric

Enough electricity is generated to power Hartland Village's elementary school and its town facilities, and those of the neighboring town of Windsor and its waste treatment plant. Today, these community needs are met by the production of the Gorge's clean, much-needed renewable energy. It seems a bittersweet nostalgia that many of the community's earlier basic commodities – woolen cashmere cloth, corn meal, split plaster lathe, and cider – were also made on site from the same power source, but just a memory now.

After lunch, we went to Windsor, VT, to see (first) the "Great Dam." The Windsor Upper Dam has stood for 185 years in Windsor, Vermont and is among the earliest storage dams

As early as 1767, several saw and grist mills were operating along Mill Brook in Windsor, Vermont. During periods of low water flow in the creek, though, the mills stood idle. The Ascutney Mill Dam Company was formed to build an upstream dam that would regulate the water flow and supply a constant source of power to the mills.

Built of cut granite, the Ascutney Mill Dam was one of the first gravity-arch dams built in the United States, and possibly the oldest masonry dam of significant size. Construction began in mid-April 1834 and was completed by mid-November. The original dam had a near-vertical downstream face built in an arch form.


(photo David J. Dunning)

Martinsville Hydroelectric's twin generator building


(photo David J. Dunning)

Old turbine parts kept on site


(photo David J. Dunning)

The 'Great Dam' at Windsor, Vermont


(photo David J. Dunning)

Ascutney Mill Pond and apparatus atop the Great Dam

Water filled up behind the dam each winter and was allowed to flow over the spillway the following spring. Much to the concern of local citizens, water and ice falling over the crest and 40 feet to the ledge below caused noise and vibrations throughout the village. Inspections found that the vibrations caused no damage to the dam, but a stone buttress was built below the dam to stop the vibrations.

The dam is 40 feet high and 360 feet long. It is 36 feet thick at the base and 2 feet thick at the crest. The ratio of base width to height, 0.9, is the ideal standard proportion to this day.

Errata, spring 2024 newsletter

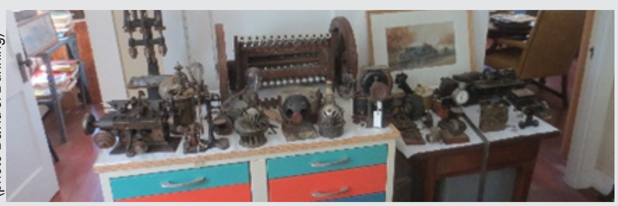
Page 11, labels for the lower two images were accidentally reversed. The advertisement with the image of the shoe is from the *Boot and Shoe Reporter*, and the advertisement for E. S. Cabot is from the *New England Business Directory*. Apologies.

The rest of the day was spent exploring the mechanical curiosities collected by Ed Battison (deceased). Jay Boeri is the curator of what Ed called "The Franklin Museum of Nature and The Human Spirit." The tremendous collection is all mechanical things, though; we didn't see anything related to the human spirit. Ed Battison also founded the "American Precision Museum" in Windsor. The town wanted to get the old vacant mill building off their books, so Ed bought it for $1. He filled the museum with industrial history artifacts, and with what didn't fit, he started this museum. Ed was always searching for interesting things to collect. Visitors can explore the barn and *try to* decipher what they are as well as (or better than) this writer could identify them. The one true identities are the Stanley Steamers, one of which is the very first built.

(photo David J. Dunning)

Mechanical curiosities to explore in the 'shed full of stuff' filled the afternoon. Among these are several Stanley Steamers, including the very first (the gray cars in the images below), and a very large trove of all kinds of apparatus relating to early industrial history. Readers are encouraged to try identifying these pieces of equipment, which remain mysteries to the author in many cases.

(photo David J. Dunning)



(photo David J. Dunning)

(photo Chip Wheeler)

(photo David J. Dunning)

(photo Richard Coughlin)

(photo David J. Dunning)

SNEC Spring Tour Report

Tour of Henry Perkins Co. Foundry & Site of former Bridgewater Iron Mfr. Co.

BETSEY DEXTER DYER

David Moore, Chair of the Bridgewater Historical Commission, arranged with the owners of the Henry Perkins Co. in Bridgewater, MA, to allow a group of New England IA chapter members to tour their iron foundry on April 18, 2024. Importantly, the tour was on a day when the foundry was operating, so IAers were able to see a typical Thursday morning of production. Tom and Dave Perkins, two of the foundry's owners, led us for a few hours through the cavernous and labyrinthine, historic plant. They, along with a third owner, their brother Peter Perkins, are fifth generation descendants of Henry Perkins, who began the foundry at that site in 1848. It was a trip scheduled just in time, as the plant will be closing later this year and its buildings (Fig. 1) razed to make way for condominiums. Eighteen SNEC and NNEC members were able to see nearly every step in the production of cast-iron objects.

Henry Perkins Company Foundry

The Henry Perkins Co. today produces "short runs" of iron castings, in a variety of iron formulation, using the Meehanite standard, a protocol that guarantees an especially high-quality product (Fig. 2). High throughput production, once done at Perkins (and many other American foundries), is now done overseas. Perkins adjusted its focus and staffing to produce orders of 1-100 castings for local companies. At its peak under the current generation of owners, the foundry had about 60 employees; that number is now 11. Typically, Perkins employees are trained on the job, and many began with little or no ironwork experience. Today it is difficult for Perkins to attract workers who want to learn foundry work.

Here, from beginning to end, is what we were allowed so generously to see. Please note that the author (a biologist) is not attempting to use every bit of terminology that an expert would, but will attempt to describe a marvelous and almost other-worldly spectacle. We were fortunate to see it for ourselves; alas, these words will fall short for readers.

Masking the sand molds

First, an exact and perfectly detailed example of the object to be cast in iron is crafted in wood; this is the pattern (Fig. 3). Making patterns is the only step done off site, by a pattern-maker. The wood pattern is coated with a silvery paint that allows it to be more smoothly released from the sand mold that will be formed around it.

Next, the pattern goes into a box, called a flask, where very fine, specially formulated sand is packed perfectly around it. This is a step we saw: initially, fine sand is sifted over the pattern and packed by hand, then more is added from a large hopper above the flask

(photo Rex Swain)

Fig. 2. Sign pitching Henry Perkins Co.'s Meehanite castings

(photo Sara Wermiel)

Fig. 1. Exterior, Henry Perkins Co. Foundry, Bridgewater, Mass.

and pounded down with a pneumatic drill-like device and also by a vigorous mechanical shaking and banging of the entire box. More and more sand is poured in until it seems as though no more sand could possibly fit, and yet more does fit, due to the pounding and shaking. Sand becomes remarkably solid when compacted this way.

Different combinations of sand, clay minerals, and coal are used for different types of castings. There were bins of these ingredients, and on a large iron plate were written various recipes for sand mixtures, as though they were on the wall of a kitchen. Amidst the formulas was a Memoriam to Shorty, a Perkins dog, who had died in 1975. And indeed, the walls of the plant had handwriting from all different eras, on all sorts of topics, a study in itself.

Some of the objects to be cast are hollow inside – imagine an iron pipe. For these, a core (Fig. 4) is placed inside the flask, positioned so the iron flows around it, making a shell. The cores also are made mostly of sand and cooked in a special oven, at 350- 400 F, until they harden. The oven we saw (Fig. 5) looked like an exceptionally efficient system for high throughput pizza baking. Many flat oven drawers could be pulled out individually and loaded with cores; then an intriguing little sliding bar on the front of each drawer could be positioned to indicate at what hour they were done. A millennium from now, archaeologists will puzzle over what the device was; it looks like a sort of sliding ruler. Indeed, throughout the plant one could see devices destined to be obsolete one day and perhaps completely forgotten. Often SNEC and NNEC have had a field trip to a long abandoned mill site and wondered aloud at how some particular artifact might have been used. It was a pleasure to see so many tools and pieces of equipment in active use at Perkins.

The next step in the casting process is to remove (by strategic cuts) the pattern from the flask – the sand is very compressed at this point, essentially a solid. The sand mold is reassembled, with a core if need be; and an opening is formed at the top of the mold to receive molten metal. There is quite an art-form (that I will not attempt to describe) in designing patterns that will create a negative

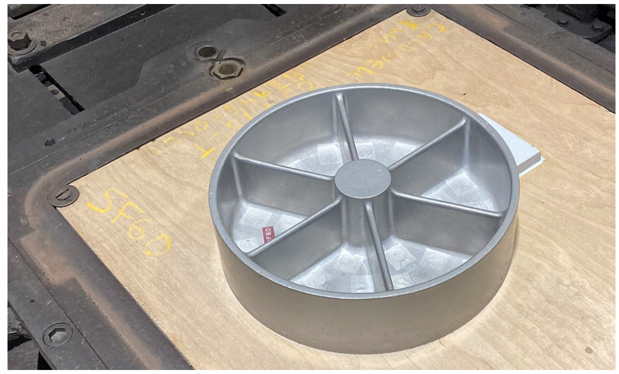

(photo Rex Swain)

Fig. 3. Example of a pattern


(photo Rex Swain)

Fig. 4. Sand molds and cores


(photo Rex Swain)

Fig. 5. Core oven

space in a sand mold into which liquid iron can flow perfectly and into every fine detail.

A sand mold is used just once, but the sand can be recycled to make another. We did not see the recycling process by which solid molds are reduced back to fine grains, but some of the same machinery used to pack and compress can be also used to break a mold apart, so that it can be crushed and screened back to sand grains.

Melting iron

Just like baking a cake, is how Tom Perkins described the steps of mixing ingredients to make the various kinds of iron used for castings (e.g., gray and ductile iron). Huge bins of pig iron and scrap iron (the main ingredients) lined the wide corridor leading to the electric furnaces, where the ingredients are combined and melted. The formulas for the iron needed for each job are specified; like other meticulous foundries, Perkins uses only its own scrap to be sure of the content. The scrap bins were of interest to SNEC/NNEC members as they were full of interesting and diverse shapes and forms.

Perhaps the most exciting part of the visit was seeing an electric furnace where the iron was melted. As we walked down this corridor toward the cauldron of the furnace, explosions of huge pyrotechnic sparks erupted from it periodically (Fig. 6). This next metaphor has been used over and over by ancient poets so it is just a trite observation here: it was like approaching Hades (or let's say a festive celebration in Hades). (But we're sorry you weren't there if you are just reading this because a festival in "Hades" isn't enough.)

The iron mix is not just about the right proportions of pig iron and scrap. Here is where a major aspect of the Meehanite process comes into play. That process is a sort of gold standard (or iron standard perhaps) that guarantees to a buyer that the iron has been mixed and assayed for exactly the right content required for the particular casting. Accomplishing this involved many steps toward getting a precise mix, and we witnessed that. An employee rushed back and forth between the furnace with the molten metal and a laboratory with a spectrophotometer by which he could analyze a sample of metal for its element content. And nearby were racks of ingredients, such as silica, carbonates, and sulfur, which could be quickly weighed and added as needed. And even that in-house analysis is not enough in developing a formulation. Samples also are sent out to an independent lab to verify content. Like mixing ingredients for a cake, perhaps; but to this author, making soup seemed apt as well. The process involved mixing, adding, tasting (spectrophotometry), more adding, mixing, tasting and so on.

(photo Rex Swain)

Fig 6. Molten iron pouring from the furnace into a bucket, or crucible, to be transported to the flasks

We stood back when it was time to pour the molten iron. The furnace was at a higher level than the large bucket, or crucible, that received the molten metal (Fig. 7). The whole furnace structure was tipped, and metal poured into the bucket (Fig 6). But even from the distance the light was so intense that we were shielding our eyes. How bright? It was reminiscent of the total eclipse of April 8, 2024, across a band of North America. Many of us had witnessed it with the correct eye-wear and it was probably fresh in our minds as we cautiously witnessed the intense glare of molten iron being poured.

Then we walked rather quickly down a long corridor to the next big section of the plant, where the molten iron traveled on a conveyor system along the ceiling. There, forty or so flasks stood ready, and we were thrilled to see the iron being poured into each one. The metal eventually cooled, but not within the time frame of our morning visit. The last steps were a machine shop and an enormous sand blaster by which pieces are finished.

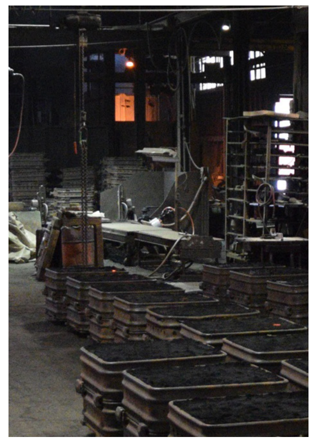
The world is full of Perkins foundry products: 124-years-worth. Most easily visible perhaps are the cast iron benches in Boston's Public Garden.

Bridgewater Iron Co. site – Iron Works Park

After saying goodbye to Tom and Dave Perkins, we motored to the nearby Iron Works Park, the former site of Bridgewater Iron Co., which in the years after the Civil War was judged to be the largest iron works in New England. After the company closed, Stanley Works of New Britain, Conn., purchased the site, in 1899, and the area came to be called Stanley. Today it is a city park. No above-ground structures from its days as an iron works remain at the site, except for the stone walls of one former warehouse. But there are ground-level and archaeological remains from its industrial days.

(photo Sara Wermiel)

Fig. 7. Top of furnace in operation



(photo Sara Wermiel)

Fig. 8. Flasks lined up, awaiting iron to be poured into them

Iron manufacturing in Bridgewater dates back to the colonial period, and members of the Perkins family were early involved with it. David Moore's detailed article about the history of the Bridgewater Iron Co. was published in two parts in the New England Chapters-SIA newsletter (Fall 2023, Spring 2024 issues). So, I will not attempt to repeat all that here.

For the tour, David thoughtfully set out labeled samples related to bog iron, to show us how to recognize the signs of it. This, of course, resulted in a discussion about what exactly bog iron is and why none of us, including David, have ever held a big chunk of it in our hands. Here is where some of my expertise as a microbiologist might help. (And this is written up in a chapter in my book, *Field Guide to Bacteria*.) Bog ore is an extremely low-grade ore with many impurities, including organic material (mosses, decaying leaves, etc.) as well as an abundance of clay and other minerals. If there were big chunks around, then we'd have operations like those in northern Michigan, where massive solid bands of high-grade iron ore can be found. Those banded iron formations were made about 2 billion years ago, at a time when iron-oxidizing bacteria had very little competition from any other organisms except their fellow microbes. Those bacteria laid down huge deposits of oxidized iron in present-day Michigan, as a waste product of their unusual metabolism. Iron oxidizing bacteria make useful sugars for themselves by removing dissolved iron from water and gaining a little energy for sugar synthesis! (And I will not attempt to elaborate much further here; read the chapter of my book if you want to know more.)

Nowadays, those iron bacteria are still doing the same thing, but amidst a cacophony of other organismal activities, including massive amounts of vegetation everywhere. So it is all done on a much more subtle scale in whatever bogs remain after human encroachment. If you want bog iron, you must look for signs of iron-rich waters and sediments: some streams almost run red, some still-water pools have metallic sheens, some rocks and leaves are coated with iron – such as the sample that David Moore showed us. Dig into that area and come up with sediments tinted red that will require lots of processing to yield somewhat pure iron. David explained some of this to us.

Then attendees were free to wander around the archaeological park and were allowed to collect samples of iron slag (a waste product of iron smelting), which is abundant after 200 years of ironwork on the site. Note that bog iron was only briefly important at the Stanley site (or anywhere in New England), because imported pig iron became so much easier to acquire and use.

Saugus Iron Works Tour

Ron Klodenski

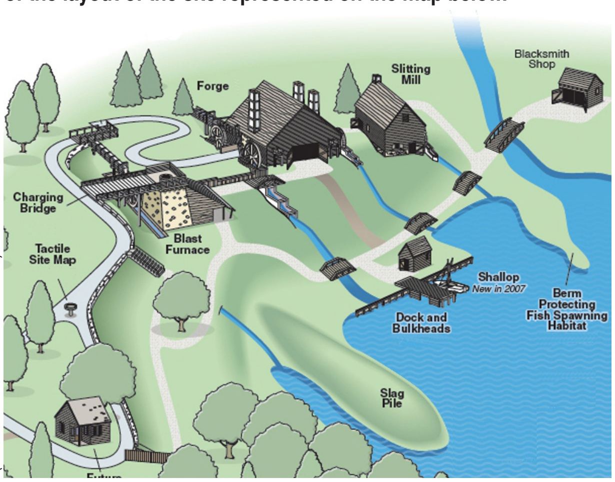
The Southern New England Chapter of SIA hosted a tour of the Saugus (Mass.) Iron Works National Historic Site on Saturday, June 29. Our event was hosted and narrated by Ranger Paul Kenworthy of the National Park Service.

Saugus Iron Works was the first successful integrated iron works in North America.[1] It was established in 1646 after an earlier iron works in Braintree, Mass., failed due to a lack of water power and available iron ore.[2] The Saugus Iron Works continued to operate for about 25 years, to 1670.[3] Today the 12-acre site contains an iron works reconstructed from archaeological evidence, documentation, and expert conjecture.

Our tour began at a scale model of the current site, where Ranger Kenworthy pointed out the major features of the iron works. From there the group followed the flow of the iron-making process, starting at the top of the blast furnace, where iron ore was smelted into pig iron and gray iron. Next, the group moved to the forge, where iron from the furnace was refined and shaped. Then came the rolling and slitting mill for shaping the forged iron into useful shapes.

(photo: Ron Klodenski)

Our guide points out site features on a tactile site map (scale model) at the start of the iron works tour. It is a 3D representation of the layout of the site represented on the map below.



(National Park Service brochure)

The final tour stop was the reconstructed warehouse, dock, and shallow-draft shallop on the Saugus River. Here on the tidal section of the river, iron works products were shipped out and raw materials were brought in over the water.

Participants finished the day with a picnic lunch on the site, accompanied with a brief talk by Betsey Dyer about the chemistry and biology of bog iron, the iron ore source for this iron works. After lunch, Ranger Kenworthy gave a few of the participants a brief tour of the so-called iron master's house, built in the 1680s. It was once thought to be the home of the iron works manager, but recent testing shows the house was built after the iron works closed.[4]

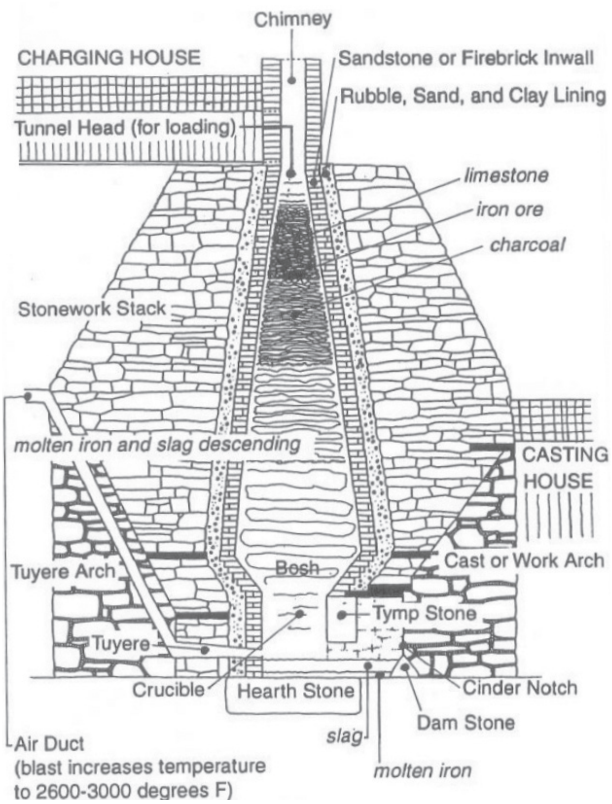
Iron works founding and demise

At the start of the tour, Ranger Kenworthy explained how John Winthrop the Younger, son of Massachusetts Governor John Winthrop, believed an iron works could make a profit by selling iron and iron products in America and England. The somewhat charismatic Winthrop was able to obtain the necessary funds from a partnership of about 25 investors, a tax exemption, and a 21-year monopoly arrangement from the Massachusetts General Court.[4]

Winthrop then established an iron works in Braintree, Mass., and started operating it in the spring of 1645. By the end of that year, however, the investors replaced Winthrop with Richard Leader, who observed that water power and ore availability were inadequate for operating the Braintree furnace.[5]

Leader immediately sought a new location for an iron works and chose this site in Lynn, on the Saugus River. (The area was later to become Saugus.) The new location had all the necessary requirements for iron-making: wood to make charcoal for smelting furnace fuel, iron ore from nearby ponds and bogs (see “About bog iron” on page 12), calcium carbonate flux from neighboring Nahant, and a 38-foot drop in the Saugus River to provide water power for the blast furnace bellows and multiple forging hammers. The tidal section of the Saugus River also offered an unobstructed water transportation route to the nearby Atlantic Ocean.

(Eggert, *Iron Industry in Pennsylvania*, 1994.)



Cross section of a cold-blast, charcoal-fueled iron furnace, similar to Saugus Iron Works furnace.

The iron-making operation started operating in 1646 under the name Hammersmith. It produced pig iron, wrought iron bars, kettles, pots, skillets, and other cast-iron products, and various shapes that other manufacturers and blacksmiths could fashion into nails, bolts, horse shoes, wagon tires, axes, saw blades, and other implements.[3]

The operation ran for 30 weeks each year and produced a ton of cast iron each day.[3]

In winter when freezing temperatures made water wheels inoperable, work continued for gathering, processing and staging wood, charcoal, and other materials that would be needed when production started again after the spring thaw.[4]

The exact reason for the Saugus works’ closure is still unclear,[4] but it seldom made a profit and was plagued by high labor costs, mismanagement, and possibly embezzlement.[3]

20th Century iron works restoration

After the iron works closure about 1670, the site was abandoned and eventually disappeared under fill and underbrush, although it was known that an iron works had operated there. But interest in the history of the site didn’t seem to develop until 1938, when the Daughters of the American Revolution purchased a piece of the former iron works property out of foreclosure. In 1943, a non-profit called First Iron Works Association (FIWA) created by William Sumner Appleton, President of the Society for the Preservation of New England Antiquities, purchased the former iron works property. After being approached by a FIWA director, a retired Bethlehem Steel executive living in Gloucester was able to convince the American Iron and Steel Institute (AISI) to fund restoration of the iron works.[3]

With funding secured, FIWA hired archaeologist Roland W. Robbins in 1948 to find the site of the iron works and Robbins soon uncovered major remains of the operation. These included building foundations, blast furnace remains, holding ponds, the canal, a 500-pound hammer used in the forge, a waterwheel that powered the bellows for the blast furnace, and its wheel pit.

Robbins went on to invest years of intensive and productive work at the site, and his devotion was thought by some to have affected his health. He left the project in 1953 following disputes with FIWA officials and the project’s architects. But restoration continued without Robbins, and the iron works opened to the public in 1954 as a private museum run by FIWA

(photo: Ron Klodenski)

Ranger Kenworthy at the base of the blast furnace describing how the molten iron was directed from the furnace crucible into crude troughs to cool and become pig iron.

and funded by the AISI. In 1961, the AISI discontinued its subsidy, and in 1968, the Saugus Iron Works was added to the National Park Service system and renamed the Saugus Iron Works National Historic Site.[3]

Editor's note: Betsey Dyer, SNEC management committee member, Wheaton College professor of biology emerita, and author of *A Field Guide to Bacteria*, contributed the following description of bog iron formation and characteristics.

About bog iron

Bog iron was the main source of iron ore for the iron works on the Saugus River. The process by which bog iron accumulates is a bacterial one. The ore is a waste product of an extraordinary type of metabolism done by iron oxidizing bacteria. It is somewhat similar to photosynthesis but instead of using light as an energy source, the chemical bonds in dissolved iron salts are the energy. Strange as that metabolism might seem, it is extremely common below the surface waters and soils of the planet. And note that most of the habitable areas (deep sediments, deep oceans) are dark and sunlight cannot be used.

The resulting bog iron (the waste product of the metabolism) is typically a very low grade ore, full of clays and organic material and requiring quite a lot of processing to get relatively pure metal. It is not surprising that when much more concentrated, ancient deposits became available, bog iron was abandoned as an economic source. Although bog iron is renewable, it is on the order of decades. If a wetland is drained, and all of the iron rich sediments are dug out, the iron is not likely to be replenished immediately. Also, although it is common to see an internet photo of someone holding a big chunk of bog iron, there were probably many more small nodules and particles; these become more visible once all the organic material (mostly plants and algae) is roasted away.

Many SNEC members are very eager to get their hands on just one piece of the ore! Draining a section of wetland (illegal in Massachusetts) and then getting some energetic younger people to dig with sharp shovels, might do it. However instead try ordering some from Ward's Science Geological Catalogue (www.wardsci.com) that supplies mineral samples to schools. (If they ask, you are using it for educational purposes in your museum or archives.)

(photo: Ron Klodenski)

Betsey Dyer describes the chemistry and biology of bog iron formation during the tour's picnic lunch at the iron works

Search bog iron as "goethite," "limonite," or even "magnetite." These are three different minerals, but you might want all three because the iron-oxidizing bacteria are not producing exactly one type of mineral but more an amorphous mix. And if you are ordering minerals, you might as well also get some "banded iron" to see the high grade ore that easily out-competes bog iron.

End notes

[1] E.N. Hartley, *Iron Works on the Saugus*, University of Oklahoma Press, 1957.

[2] "John Winthrop Jr. Iron Furnace Site," *Wikipedia*, https://en.wikipedia.org/wiki/John_Winthrop_Jr._Iron_Furnace_Site.

[3] "Saugus Iron Works National Historic Site," *Wikipedia*, https://en.wikipedia.org/wiki/Saugus_Iron_Works_National_Historic_Site.

[4] Paul Kenworthy, NPS Ranger, narration during 6/29/2024 iron works tour.

[5] "The Fairbanks Family and the First Successful Ironworks in the Massachusetts Bay Colony: Part I," https://www.fairbankshistory.com/colonial-history/the-fairbanks-family-and-the-first-successful-ironworks-in-the-massachusetts-bay-colony