Northeast Historical Archaeology

Volume 29 | Article 4

2000

Towards An Archaeology of the Hudson River Ice Harvesting Industry

Wendy Elizabeth Harris

Arnold Pickman

Towards An Archaeology of the Hudson River Ice Harvesting Industry

Cover Page Footnote
We are grateful for the assistance we received during the preparation of this article. We would like to thank the following: Norman Brouwer, South Street Seaport Museum, New York, New York; Cynthia Blakemore, Mark Peckham, and Paul R. Huey, New York State Office of Parks, Recreation and Historic Preservation, Waterford, New York; Raymond Beecher, Shirley McGrath, Louise Messinger, and Judith Rundell, Vedder Memorial Library, Greene County Historical Society, Coxsackie, New York; Helen McLallen, Columbia County Historical Society, Kinderhook, New York; Dave Smalley, Stuyvesant, New York; Chris Pyslopski, Palisades Interstate Park Commission, Bear Mountain, New York; Irene Saganich, Mary Bol, and the members of the Esquatak Historical Society, Castleton, New York; Ann K. Legenbauer and the members of the Poestenkill Historical Society, Poestenkill, New York; William F. Petronis, Daniel Karlok, Marc Forstell, and Richard Campbell, Albany Field Office, Operations Division, New York District Corps of Engineers, Troy, New York; Nancy Brighton, Eugene Brickman, Jeffery Cusano, Jeffery Fry, Roselle Henn, Nikoleta Katsakiori, Dag Madara, Lynn Rakos, and Joseph Vietri of Planning Division, New York District Corps of Engineers, New York City; and Peter Shugert and David York of the Public Affairs Office, New York District Corps of Engineers, New York City. We especially wish to thank the staff of Northeast Historical Archaeology, including Mary Beaudry and Stephen Brighton, and two anonymous reviewers. Their feedback, comments, and suggestions gave us new perspectives on our research and writing. Much of the research for this article was funded by the New York District of Corps of Engineers, which does not necessarily agree with all the conclusions cited above or bear any responsibility for them.

Towards An Archaeology of the Hudson River Ice Harvesting Industry

Wendy Elizabeth Harris and Arnold Pickman

During the late 19th and early 20th centuries, natural ice cut from the Hudson River provided the New York City metropolitan area with much of its supply. This article briefly examines the history and technology of this industry, and its impact on local workers, communities, and landscapes. The documentary history and visible remains of three ice house sites are analyzed, with ice house technology viewed as an integrated system of production and transportation. Results suggest that archaeological examination of such sites can be used to study variations in ice industry technology and reveal features not mentioned in the documentary record. Aerial photography and shoreline reconnaissance indicate that archaeological remains of many Hudson River ice houses are still preserved. These should be studied before they are destroyed by development.

Au cours de la fin du XIXe siècle et du début du XXe, la coupe de la glace sur l'Hudson a fourni à la région métropolitaine de la ville de New York une bonne partie de son approvisionnement. Cet article examine brièvement l'histoire et la technique de l'industrie et son impact sur les travailleurs, les localités et les paysages locaux. Il analyse l'histoire documentaire et les vestiges visibles de trois sites de glacière, la technique de la glacière étant considérée comme un système intégré de production et de transport. Les résultats indiquent que l'examen archéologique de pareils sites peut servir à étudier les variations de la technique de l'industrie de la glace et révéler des particularités non mentionnées dans le dossier documentaire. La photographie aérienne et la reconnaissance des bords du fleuve indiquent que des vestiges archéologiques de plusieurs des glacières de l'Hudson subsistent encore, vestiges qu'il faudrait étudier avant leur destruction par l'expansion immobilière.

Introduction

This study of the history and archaeology of the natural ice industry is part of a larger investigation of 19th-century Hudson River landscape transformations associated with the development of industrial capitalism. Elsewhere we have noted that the river's industrial history has often been suppressed in the effort to protect the river's natural resources (Harris et al. 1996; Harris and Pickman 1996, 1997). In the press, and in popular and scientific literature, the Hudson River landscape has been represented as a "world apart," a landscape in need of "preservation," or as an ecosystem that is being "restored" (Revkin 1996; Smith 1996; Stevens 1996). This perception, however, obscures an extensive history of interaction between human beings and the physical terrain that comprises the Hudson River Valley. Ironically, this landscape—its pastoral reaches interspersed with abandoned brickyards and derelict barges—is itself a visible record of the nation's economic history, a history encompassing the rise of industrial capitalism and the transition to a post-industrial economic order. The industrial archaeology of the Hudson River thus assumes significance as a neglected aspect of the river's history.

What follows is an examination of a quintessentially 19th-century Hudson River industry—ice harvesting. Several aspects of the industry are discussed including its history; its effect upon the people and the communities involved; changes in the riverine landscape that occurred as a result of ice house construction; and finally, the results of preliminary archaeological field investigations at three Hudson River ice house sites. These ice houses, constructed by J. Scott & Company, P. McCabe & Co., and Van Orden, Vanderpool, & Sherman, were located on Schodack-Houghtaling Island, some 15 miles (24 km) south of Albany, New York (FIG. 1).

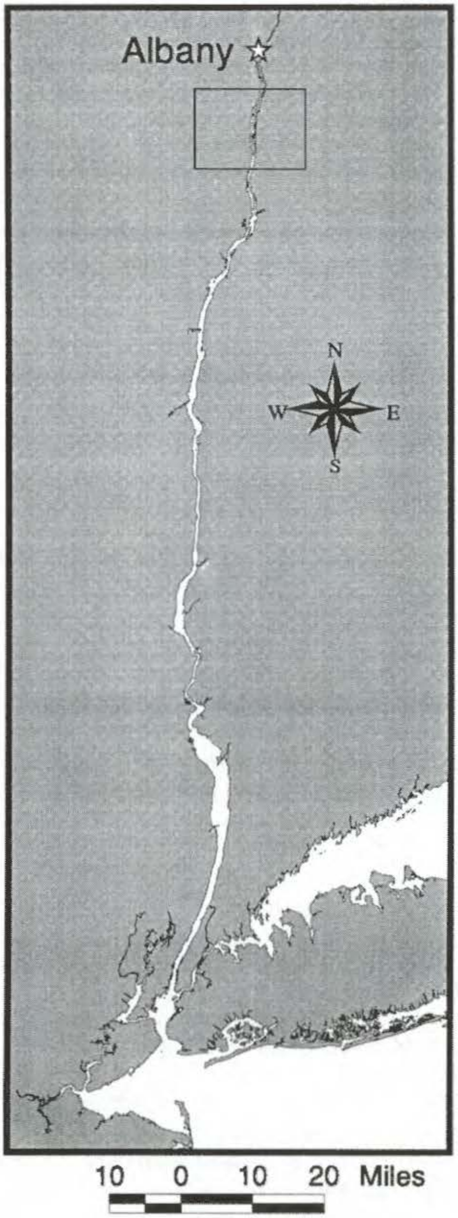

Figure 1. The area within the box includes Schodack-Houghtaling Island, a group of three interconnected Hudson River islands. In the late 19th and early 20th centuries, the island was the location of 13 ice house complexes, including the three discussed in this article. (Drawn by Dag Madara.)

The Rise and Decline of the Hudson River Ice Industry

During the 19th and early 20th centuries, the harvesting, storage, and shipment of natural ice was one of the Hudson River's most important economic activities. As with other Hudson River industries, the development of the natural ice industry had its roots in the economic ascendancy of New York City. Much of the impetus for this growth is traceable to the completion of the Erie Canal in 1825, giving the city access to western markets. While the canal was an outgrowth of mercantile capitalism, it ushered in a subsequent economic regime during which New York Harbor became "the center of one of the world's great industrial regions" (Spann 1981: 402). Navigation improvements transformed the river from a natural waterway into an engineered corridor for moving goods between the port of New York and its hinterlands. Steam traffic and the newly developed Hudson River Railroad allowed the delivery of coal, machinery, and building materials to new industrial facilities that were being established along the river. Thus the river, having contributed to the creation of the New York market, and having provided the means to bring commodities to that market, now experienced the industrialization of portions of its own shorelines. This led to further changes in the river's morphology through the creation of land and facilities to support industrial production (Harris et al. 1996; Harris and Pickman 1996, 1997). One of the first industries to be developed on the Hudson was the ice industry, which centered upon the extraction of the frozen waters of the river itself, transforming this raw material into a commodity—standard-sized blocks of ice that were stored in enormous ice houses until the summer months and then shipped by barge down the river to New York to be sold to city dwellers.

The origins of the American natural ice industry were in New England—its inception generally credited to Frederick Tudor of Massachusetts. Tudor's business venture, which began in 1806, centered initially around the shipment of ice from Massachusetts to such tropical destinations as Martinique, Cuba, and other Caribbean ports. The firm eventually grew to the point where it was shipping ice overseas to India and other countries, as well as to domestic ports, including Charleston (Maclay 1895; Smith 1961).

The success of Tudor's ice-harvesting operation is attributable not only to his seizing of a marketing opportunity, but also to the ingenuity of his foreman, Nathaniel J. Wyeth, and another employee, John Barker, who are credited with the invention of the above-ground ice house as well as ice-harvesting tools that permitted the large-scale harvesting of ice from ponds and rivers (Maclay 1895; Sharples 1907; Stott 1979). By 1855, the Massachusetts ice industry had expanded to include a total of 12 Boston-area companies. The major source of ice for these firms consisted of local ponds, as well as the Kennebec and Penobscot Rivers in Maine (Smith 1961).

By the 1830s, the expansion of urban centers in the northeastern United States created sufficient demand to stimulate the development of local commercial ice-harvesting ventures (Cummings 1949). The Hudson River ice industry had its beginnings with the harvesting of ice from Rockland Lake in the 1830s. Three Rockland Lake firms consolidated in the 1850s as the Knickerbocker Ice Company, which later became one of the largest of the Hudson River ice companies (Stott 1979). While Hudson River ice was apparently shipped to other American cities and foreign ports (Maclay 1895; Stott 1979), New York City constituted the major market for the Hudson River ice houses.

Urbanization and the elaboration of the metropolitan New York City area's infrastructure stimulated the growth of commercial ice harvesting. Between 1840 and 1860 the city experienced a 160% increase in population (Spann 1981: 430). Individual households, as well as hotels, restaurants, and other industries in the rapidly expanding city all required ice for food preservation and beverage cooling. In 1855 a total of 75,000 tons of ice was sold in New York City (*Ice Trade Journal* 1883b: 1). By the 1880s, this figure had reached approximately 2.5 million tons. To meet this demand, approximately 135 commercial ice houses had been constructed between New York and Albany, providing ice to the New York City market (Hall 1884: 24–26).

As the natural ice industry grew, small locally owned companies such as those that owned the ice houses discussed in this paper were absorbed and consolidated into large corporations, such as the American, National, and Knickerbocker Ice Companies. These well-financed companies eventually invested in mechanical refrigeration equipment and in facilities closer to the New York City market (Beecher 1988: 27; Stott 1979: 11).

By the mid-1920s the development of economically efficient means of producing commercial quantities of artificial ice and the subsequent introduction of home refrigerators led to the demise of the natural ice industry. Most of the ice houses that lined the Hudson River shorelines were abandoned, although some were used by commercial mushroom growers. Over time the ice houses were either demolished, fell into decay and ruin, or were destroyed by fire (Beecher 1991: 81). Today, the material remains of the ice industry lie buried under landfill, submerged in the mud of the riverbanks, or covered by thick vegetation.

The Hudson River Ice Industry Work Force

In the latter portion of the 19th century the Hudson River ice houses became a major factor in local economies, and for workers in river communities their construction was a welcome development. During the third and fourth quarters of the 19th century, most of these workers engaged in seasonal pursuits such as agriculture, logging, fishing, ship building, brickyard work, and river transportation—all of which ceased during the winter months (Hall 1884: 26; Post n.d.). Thus the ice houses provided a new income source to farmers, artisans, and tradesmen. Estimates place the size of the Hudson River ice industry seasonal work force at up to 20,000 workers (Hall 1884: 26). In the 1900-1901 season, when two-thirds of the Hudson River ice originated between Catskill and Troy, the industry in this area provided employment to at least 6000 men, filling the local hotels and boardinghouses (Beecher 1988: 1–3).

Work in the ice industry also extended beyond winter. Commenting on Greene

County's 40 ice houses, Beers (1884: 58) noted: "The business gives employment to a large number of men, both in harvesting the ice in the winter and breaking it out and loading barges in the summer." In addition to the funds that flowed directly to the workers, the economic power of the ice industry also derived from its indirect impact upon the local economy as ice house employees spent their money in hotels, boardinghouses, restaurants, saloons, clothing stores, and other retail establishments (Beecher 1991: 79).

Like the industry they labored in, the history and culture of Hudson River ice house workers have been largely forgotten. Sources suggest that like other members of the region's rural working class—a group that included agricultural laborers, quarry workers, brickyard workers, fishermen, stone masons, loggers, shingle makers, trappers, tannery workers, charcoal burners, and berry pickers—the ice house workers pieced together a livelihood composed of an array of seasonal occupational categories (Beecher 1979, 1991; Evers 1972; Fried 1995; Gutman 1977; Lenik 1992; Post n.d.; Samuel 1975; Snyder and Beard 1981).

To further explore the composition of the ice house work force, we examined the records of the Van Orden, Vanderpool, and Sherman Ice House, constructed in 1881 on the western shoreline of Houghtaling Island opposite the village of New Baltimore. Weekly payrolls from the 1889 harvesting season list 66 persons, a figure that apparently included both year-round and seasonal workers (Sherman 1889b, 1889c). The names of 20 of these workers also appear in the 1892 New York State census records and directories for two adjacent villages on the west bank of the New Hudson (Lant 1892; New York State 1892). Six of these workers were described as farmers, while three others were river pilots or boatmen. The other workers included two carpenters (one a ship carpenter), a painter, a stonemason, and a butcher. Another, described as an engineer, apparently operated the ice house steam engine, and may have been a year-round employee. Only five of these ice house workers were described as laborers. Two of the ice house employees were substantial landowners—one of the farmers having 139 acres, and one of the carpenters, 92 acres. The butcher also owned an acre of land. This small sample supports the inference that many ice house employees were unaccustomed to working as industrial laborers.

The development of the ice industry brought communities into a new relationship with the frozen riverine landscape. Residents were now laboring in and economically dependent upon a space that they had previously only experienced visually. Newspapers such as the *Catskill Examiner* ran special columns during the winter months devoted wholly to the progress of the harvest. One column proclaimed that "ice is the only the only thing talked about in New Baltimore now" (*Catskill Examiner* 1883a). During warm winters, when the ice harvest was poor, the columns chronicled the dismal mood of the villages:

> The ice grows less and less encouraging. We have had and are having uniform spring weather...up the river the ice men have done nothing and below us it is of course the same...the laboring class feel the loss of their work on the ice very severely and when they suffer, the interests of the business community are seriously affected. (*Catskill Examiner* 1880)

During good harvest seasons, when the winters were cold, the workers had employment, but this involved exposure to the harsh, and often dangerous, working conditions on the ice fields. The diary of ice house owner Augustus Sherman attests to numerous days of sub-zero temperatures, and days when the wind and the temperature created conditions so severe that work became impossible (see, e.g., Sherman 1882, 1889a, 1895). Both secondary accounts and journals of the ice men indicate that working on the ice had other hazards that sometimes led to severe injury or even death. Accidents recounted in the local newspapers and elsewhere include falling through the ice or open channels into the freezing water, being struck by falling ice cakes which weighed up to several hundred pounds, and being ensnared in the ice house elevating machinery (Beecher 1979: 3; Rothra 1988:18).

Figure 2. Undated photograph of Hudson River ice crew marking the ice prior to cutting, near Catskill, NY. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

While the wages earned in the ice fields provided a needed supplement to local incomes, ice workers also encountered, possibly for the first time, relations of production typical of industrial capitalism. The process of being incorporated into the wage labor system was not always a smooth one as suggested by the many accounts of strikes on the Hudson River ice fields. Some affected single ice houses and were quickly resolved. Others were more widespread and involved violence and threats of violence (*Catskill Examiner* 1875, 1876, 1879, 1883a, 1883b; *Coeymans Herald* 1879, 1881c, 1882). Thus, for the farmers, artisans, and tradesmen listed in the Vanderpool, Van Orden, and Sherman payroll, life in the ice fields may have provided an initial personal encounter with labor strife. Participation in the ice industry work force also brought many workers into contact with men and women of other ethnic and cultural backgrounds. Contemporary newspaper accounts note that the ice industry's labor force included African Americans and women, as well as Irish and Italian immigrants (*Catskill Examiner* 1875, 1878).

The following quote is from an atypically pro-labor local newspaper account of an 1875 strike on the ice fields:

> By 10 o'clock the crowd numbered about 500 tough and determined men, many of whom had come from points 8 to 10 miles [13 to 16 km] distant to get work, and they formed a line and marched up and down Main Street. ...The procession comprised all nationalities, including a liberal infusion of the Hibernian element—fairly spoiling for a fight—and was peppered with Anglo-Africans. ...Pale faces and darkies met in peace on the platform of "fourteen shillings a day." (*Catskill Examiner* 1875)

While this account reflects racial and ethnic attitudes typical of the period, it also indicates the workers' solidarity in the face of what they perceived as economic exploitation by the ice house owners. Thus, within the larger Hudson River landscape, ice fields and ice houses became sites of both human conflict and accommodation as a generation of workers was absorbed into the culture of the new industrial society.

Ice Harvesting: The Process and Its Built Environment

The ice-harvesting process was essentially a simple one. The season began in late January or February, depending on the weather. Work crews went out onto the ice, scraping off the snow cover if necessary. Using horse-drawn "markers" they gridded out a field into "cakes" typically measuring 22 × 32 in (56 × 81

Figure 3. Undated photograph of Hudson River ice crew cutting ice near Catskill, NY. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

cm) (FIG. 2). Using horse-drawn cutters, the ice workers would subsequently deepen the marked grooves to the point at which the cakes could be easily separated with handsaws (FIG. 3). Channels leading to the ice house were then opened, and large "rafts" consisting of 12 to 30 cakes were floated down these channels to the ice house (FIG. 4). The cakes were separated and guided by workers onto floating aprons at the shoreline. The aprons were connected to steam-powered elevators that hoisted the cakes to sloping wooden "runs" leading to narrow vertical doors extending the full height of the ice house (FIG. 5). Finally the cakes were transferred by work crews onto chutes that fed the various internal rooms, where they were carefully stacked. In the late spring, the ice blocks were slid down wooden ramps into waiting barges for the trip to New York City and other markets (Hall 1884; Jones 1984; Stott 1979; Walsh 1983).

Research indicates that the configuration of a Hudson River ice-house complex and the machinery it contained varied considerably. Its basic units, however, consisted of the wooden ice house itself, an adjoining powerhouse constructed of wood or brick, and an iron-pipe or brick chimney stack, the latter reaching heights of up to 50 ft (15.2 m). Also present were outbuildings such as tool sheds and barns for the horses used in ice cutting. Some of the larger ice houses maintained boardinghouses for workers. The complex was oriented towards the river. A stone-filled wharf lined with timber piles protruded outward from the shoreline. In the spring barges designed for transporting ice to New York City and other urban markets surrounded the wharf (Beecher 1979, 1988; Paul 1976; Stott 1979; Walsh 1983).

The ice houses were immense hangar-like buildings, up to 300 to 400 ft (91.4–121.9 m) long, 100 ft (30.5 m) in depth, and three to four stories high. In 1881, the capacity of Houghtaling Island's Scott Ice House was 18,000 tons (*Ice Trade Journal* 1881). Other Hudson River ice houses held as much as 60,000 tons of ice (Jones 1984: 80). Many ice houses had double walls packed with insulating materials, such as wood shavings, sawdust, or hay, which would also be packed around the ice blocks. In addition, the ice houses were generally painted a brilliant white to reflect the sun's rays and further retard melting. A properly packed ice harvest could stay in storage from two to three years (Hall 1884: 9–10).

By rural 19th-century standards, the ice houses were imposing structures, and clusters of them lined the waterfronts of small villages such as Catskill, Coxsackie, and Athens in Greene County, as well as the shorelines of isolated islands and reaches of the river (Beers 1891; Bruce 1888, 1903). Their visual impact would have been heightened by their brilliant white exteriors. The writer of a 19th-century guidebook described them as "a line of immense storehouses that line the banks of the river. . . all the way to the head of navigation, and which form a feature of the scenery more conspicuous than ornamental" (Ingersoll 1893: 129). Figure 6 shows the locations of 68 ice-

Figure 4. Undated photograph of Hudson River ice crew floating ice cakes in a channel near Catskill, NY. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

Figure 5. Undated photograph of Hudson River ice house with additional ice stacked beside it. Visible at the left side of the photograph are the steam-powered elevators for hoisting ice cakes from the river and the wooden "runs" that carried the ice cakes through the vertical doors into various internal rooms. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

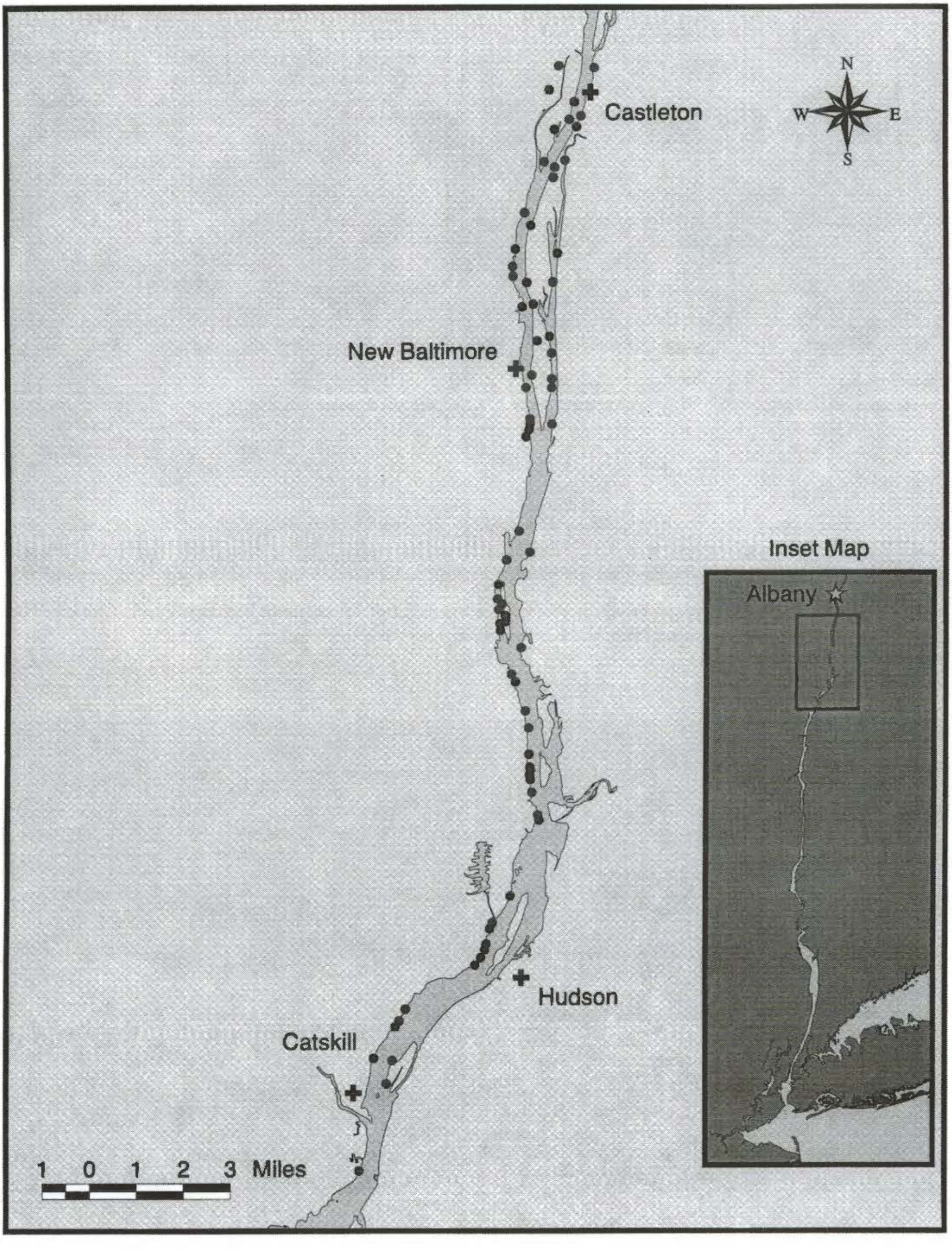

Figure 6. Locations of Hudson River ice houses between Catskill and Castleton, NY, ca. 1890s. The locations were plotted using maps of that period (Beers 1891; USACE 1897), aerial photographs (Col-East Inc. 1989), and 20th-century topographic maps (USGS 1953a, 1953b, 1953c, 1953d). (Drawn by Dag Madara.)

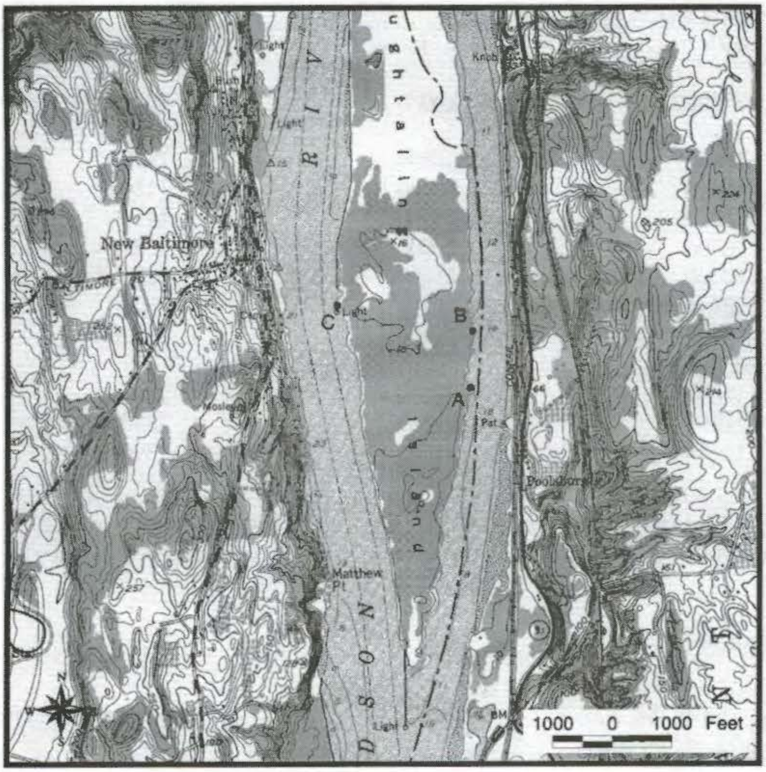

Figure 7. Map of Schodack-Houghtaling Island (USGS 1953d) showing the locations of Ice House Site A (the J. Scott & Company Ice House), Ice House Site B (the P. McCabe & Co. Ice House), and Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House).

house complexes along the Hudson River shoreline between the villages of Catskill and Castleton in the early 1890s. In addition to providing a basis for estimating the anticipated frequency of ice house remains along the shoreline, this map also conveys a sense of how these structures once dominated the landscape.

Archaeological Investigation of Three Hudson River Ice House Complexes

Background

Schodack-Houghtaling Island (also known as Castleton Island) comprises 1800 undeveloped acres straddling the boundaries of Columbia, Greene, Albany, and Rensselaer counties. Most of the island belongs to the State of New York, with the exception of a small parcel on the southern tip of the island owned by the United States Army Corps of Engineers (USACE). Extending for a distance of 6.5 mi (10.5 km), Schodack-Houghtaling Island is composed of three interconnected islands: Upper Schodack, Lower Schodack, and Houghtaling islands. Although they were originally separated by open water, these three islands and several smaller ones were transformed into a single landmass as a result of the engineering of the river during the late 19th and early 20th century (Harris and Pickman 2000). The early history of Schodack-Houghtaling Island, particularly its Native American and historic-period Euro-American occupation, has been addressed by Paul Huey (1992–1993, 1998).

Documentary sources indicate that 13 ice house complexes were located on Schodack-Houghtaling Island, the earliest of which were constructed in the late 1870s and early 1880s (FIG. 7). Visible remains of nine of these complexes were located during cultural resources studies of the island conducted by USACE and

Table 1. Capacity of Houghtaling Island ice houses (tons).

Year	Ice House A	Ice House B	Ice House C
Hall [ca. 1881]	15000	10000	10000
1881	18000		
1882	18000	10000	11500
1883	18000	10000	11500
1884	18000	10000	11500
1885*	18000	20000	12500
1886	18000	21000	12500
1897	18444	31245	18000
1901	20000 (or 15000)	41000	18500
1905	15000	41000	27000
1910	14959	41662	28908
1915	14959	41662	28908

Sources: Hall 1884; *Ice Trade Journal* 1881, 1882a, 1883a, 1883b, 1884, 1885, 1886, 1897, 1901, and successor publications *Cold Storage and Ice Trade Journal* 1905, 1910; *Refrigerating World* 1915.

* 1885 figures for amount housed.

by the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) (Harris and Pickman 1999; Huey 1998).

Investigations of three ice house sites located on USACE-owned lands were undertaken during the spring and summer of 1998 in order to assist USACE in addressing its management responsibilities towards federally-owned historic properties as mandated in Section 110 of the National Historic Preservation Act of 1966. The sites, shown in Figure 7, include the J. Scott & Company Ice House (Ice House Site A), the P. McCabe & Co. Ice House (Ice House Site B), and the Van Orden, Vanderpool, & Sherman Ice House (Ice House Site C). The investigation of the three sites consisted of documentary research and fieldwork. In addition to recordation and mapping of aboveground remains, we undertook a limited program of shovel testing, as well as an assessment of several semi-submerged vessels. In order to further interpret the observed remains at these sites, we also visited and partially recorded the best preserved of the Hudson River ice houses, the National Register listed Scott Brothers' Ice House on Nutten Hook, in nearby Stuyvesant, on the east shore of the Hudson, some 7 mi (11 km) south of Schodack-Houghtaling Island (NYSOPRHP 1984).

Documentary History

Two of the investigated ice house sites are located on the eastern shore of Schodack-Houghtaling Island. These facilities front on Schodack Creek, the channel separating the island from the mainland. The documentary sources indicate that the southernmost of these, Ice House Site A, was built by J. Scott & Company in 1881 (*Coeymans Herald* 1880, 1881a, 1881b). At the time of its construction it had the capacity to hold 15,000 tons of ice (see TAB. 1). By 1897, it had been acquired by the McCabe Brothers Ice Company, owners of two other Schodack Creek ice houses (including Ice House B) and by 1915 its owner was the National Ice Company, a large corporation (*Refrigerating World* 1915; USACE 1915). The USACE map of 1915 (FIG. 8) depicts it as measuring approximately 150 ft (45.7 m) north-south and 125 ft (38.1 m) east-west, with what appears to be a powerhouse adjacent to its eastern wall. Ice House A was no longer standing by 1929 (USACE 1929).

The P. McCabe & Company Ice House, designated Ice House Site B, was also located on the island's eastern shoreline, approxi-

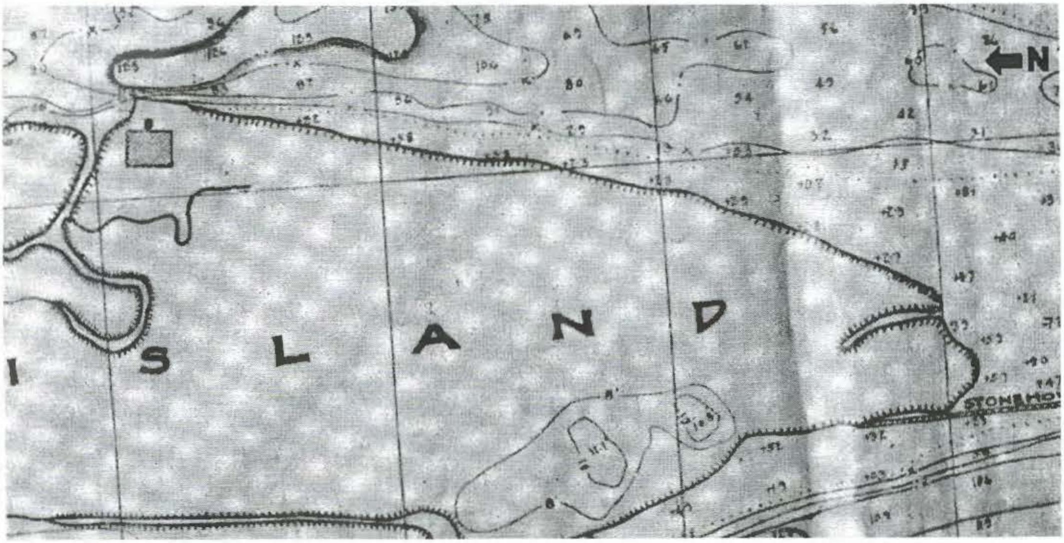

Figure 8. Ice House A (the J. Scott & Company Ice House) appears in the upper lefthand corner of this map detail. A powerhouse is indicated adjacent to its eastern wall. A wharf is shown on the shoreline to the north and east of the ice house (USACE 1915, scale of original map 1/5000).

mately 800 ft (244 m) north of Site A. Built in 1881 by Peter McCabe (Beers 1884: 373), this ice house underwent a series of expansions, increasing its capacity from 10,000 to 41,000 tons (see TAB. 1), making it one of the largest ice houses on the island by 1901. Between 1910 and 1915 the McCabe Ice House was sold, along with Ice House A, to the National Ice Company (*Cold Storage and Ice Trade Journal* 1910; USACE 1915). Maps depict it as measuring 385 ft (117 m) north-south and 125 ft (38 m) east-west, with a powerhouse at its northeastern corner (FIG. 9). A 1935 USACE map depicts the structure as "ruins" (USACE 1935).

The third ice house site investigated adjoins the Hudson River on the western shoreline of Schodack-Houghtaling Island. Designated Ice House Site C, it contains the remains of the Van Orden,Vanderpool and Sherman Ice House, the most thoroughly documented of the three ice house sites. The principal partner in this venture was Augustus Sherman (1844–1898), grandson of the builder of New Baltimore's first ice house, ca. 1853–1854. Construction of the building began in the summer of 1881 and continued through the fall. When completed, this ice house measured 150 × 100 ft (45.7 × 30.5 m) (FIG. 10). It contained four storage rooms, which were approximately 37 ft (11.3 m) in height, with a storage capacity of 11,237 tons. The operation was steam powered, the boiler and engine being supplied by English and Best of Castleton. A 45 ft (13.7 m) iron smokestack, supplied by the Albany firm of Sullivan and Rice, adjoined the structure. The wharf was gravel filled and supported by oak pilings. The first harvesting of ice took place in January of 1882 (Beecher 1988: 21–28; Sherman 1881).

In 1896, Andrew Vanderpool, Edmund Van Orden, and Augustus Sherman dissolved their partnership and sold the ice house to the firm of Hyer and Watson (Sherman 1896; Vanderpool et al. 1896). Shortly afterwards the ice house was apparently extended an additional 100 ft (30.5 m) to the south to increase its capacity to approximately 18,000 tons of ice (see TAB. 1). This configuration is shown in an undated photograph apparently taken during the turn-of-the-century period (FIG. 11). Another expansion occurred between 1901 and 1905, adding additional footage to the structure's eastern side and increasing the ice

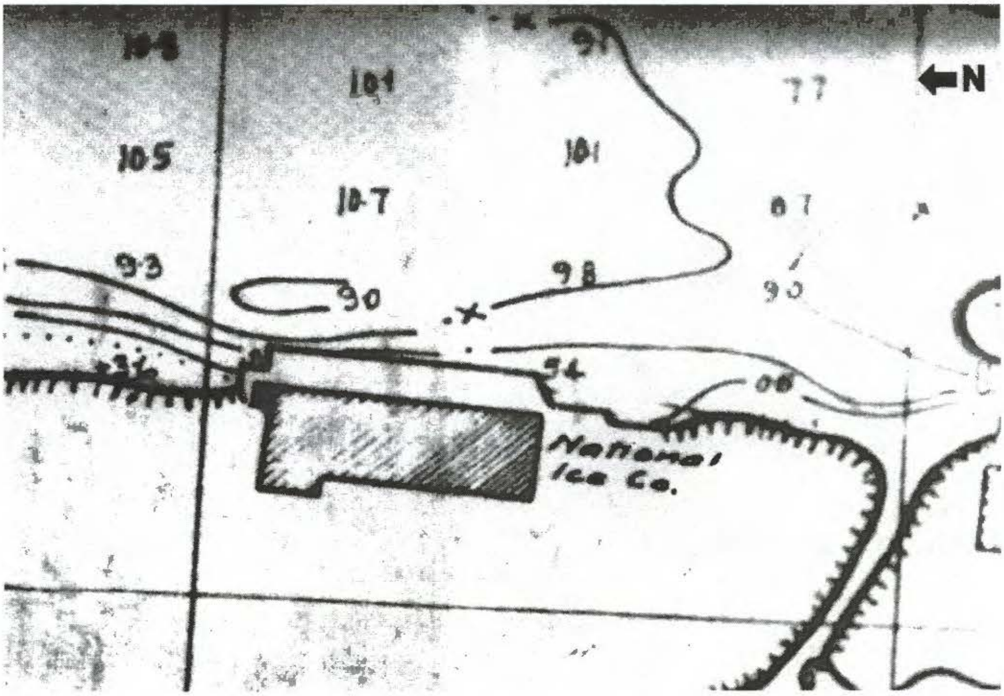

Figure 9. Ice House Site B (the P. McCabe & Co. Ice House) appears in the center of this map detail. A powerhouse is indicated at its northeastern corner. A wharf is shown on the shoreline in front of the ice house (USACE 1915, scale of original map 1/5000).

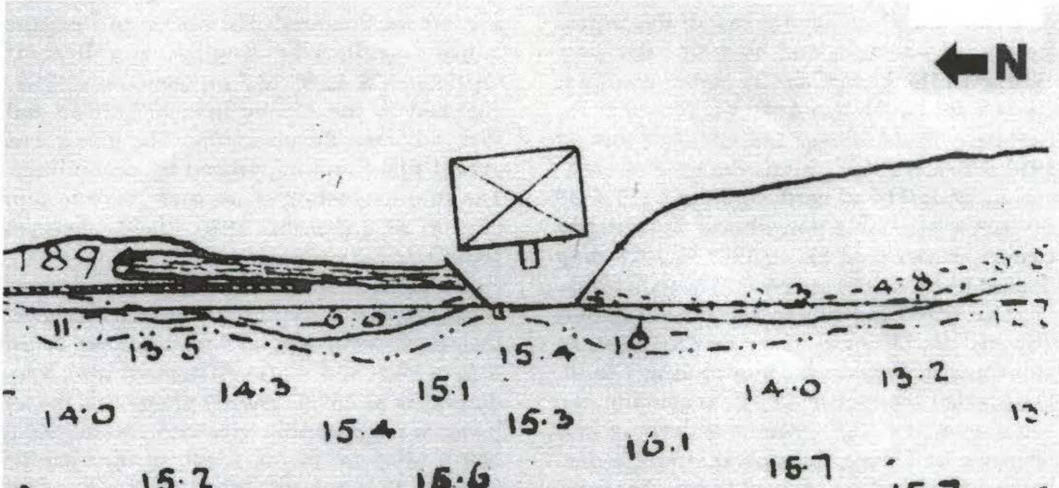

Figure 10. Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House) appears in the center of this map detail. A powerhouse is indicated adjacent to its western wall and a wharf is shown on the shoreline in front of the ice house (USACE 1897, scale of original map 1/5000).

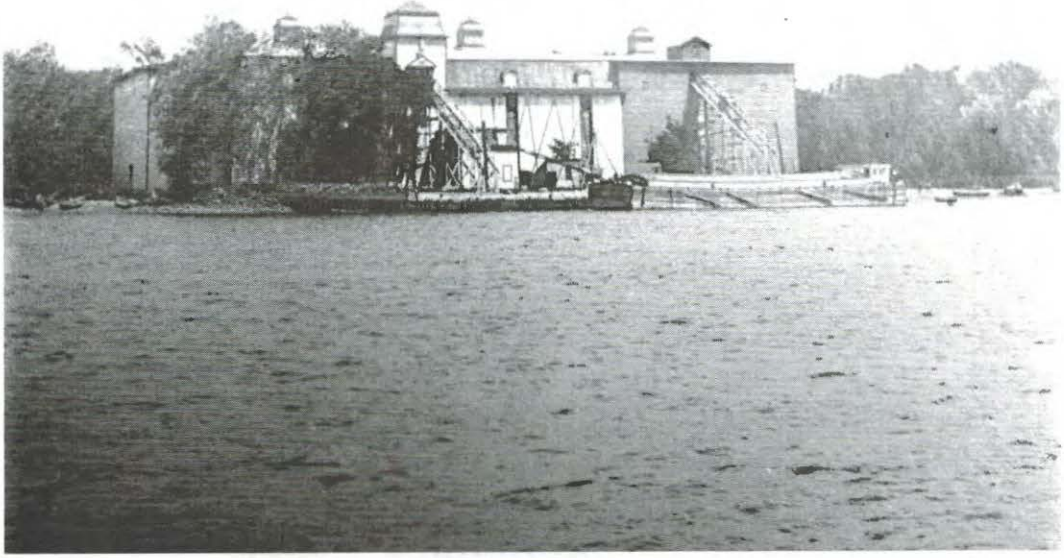

Figure 11. Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House) depicted in a photograph apparently taken at the turn of the century. The portion of the structure at the right is a post-1896 extension. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

house's capacity to approximately 28,900 tons (see TAB. 1). Like the other ice houses, Ice House C ceased operations by the late 1920s (USACE 1929).

Plans of the visible remains at all three ice house sites are shown in Figures 12, 13, and 14. These remains are discussed and interpreted below.

Analysis of Ice House Remains

For purposes of analysis, the ice harvesting industry can be viewed as incorporating an integrated system of production and transportation. Production subsystems include ice harvesting, ice storage, power generation, and ice house loading and unloading. The first of these—harvesting—involved the use of various types of manual and horse-drawn tools on the frozen river in order to cut cakes of ice and move them to the shoreline in front of the ice house. Since these activities occurred on the river's frozen surface, no *in situ* evidence of the harvesting process is preserved in the archaeological record, although it is possible that some of the harvesting equipment survives at the sites.

The remains of elements of the other three production subsystems and the transportation subsystem, however, are preserved at the ice house sites. The storage subsystem—that is, the ice house itself—is represented archaeologically by foundation walls, and, possibly, at some sites, by surviving floors and/or floor drains. The power generation subsystem—the machines that supplied the ice house with power and the structures housing this machinery, as well as the loading and unloading sub-systems—is represented archaeologically by the foundations of ice house powerhouses, associated machinery support bases, various internal powerhouse elements, and by support bases for elevators and/or ramps used to load and unload the ice house. The transportation subsystem at the Hudson River ice houses is represented by the remains of docking facilities and barges used to transport the ice to market.

The technology of the ice-harvesting industry is well documented in a general

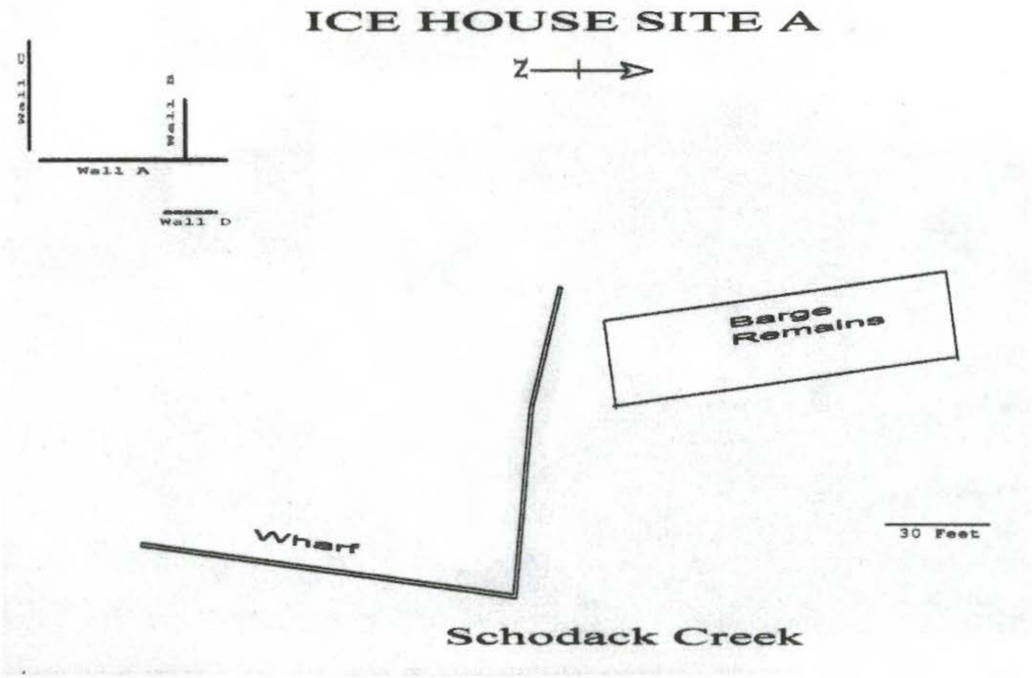

Figure 12. Ice House Site A (the J. Scott & Company Ice House). Plan of visible remains.

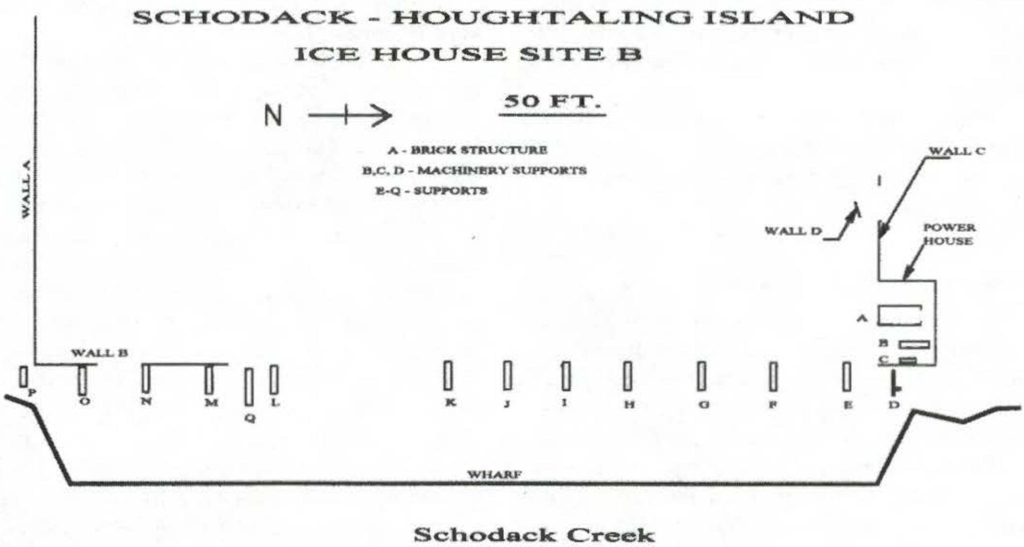

Figure 13. Ice House Site B (the P. McCabe & Co. Ice House). Plan of visible remains.

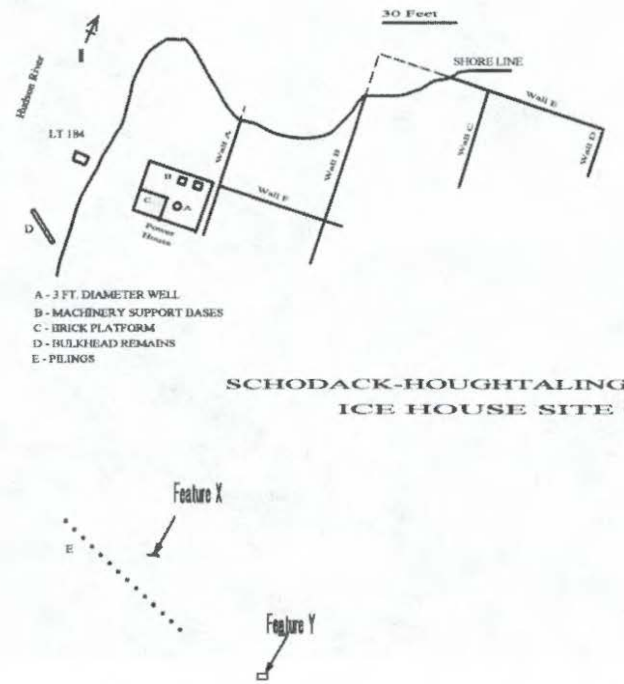

Figure 14. Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House). Plan of visible remains.

sense. Detailed descriptions of machinery and ice house construction appear in various equipment catalogues and trade publications. Sanborn insurance maps provide information about the layout of ice houses located in more populous areas. Photographs, contemporary newspaper accounts, and oral histories are also plentiful. Examination of these sources indicates, however, that the configuration of the subsystems just described varied considerably among ice house operations. Additionally, the limited fieldwork conducted to date has indicated the presence of elements not described in the documentary record. The specifics of how individual ice houses actually operated and the functional relationships among the various components remain unclear. The task of interpretation is made more difficult as a result of the fact that all of the Hudson River ice houses have been destroyed and most of the machinery removed for salvage. Today sites are covered with dredge spoil and other deposits and obscured by thick vegetation. The objectives of ice house archaeology, therefore, include the identification of remains of the subsystem elements and determination of the extent to which differences in configuration result from technological, temporal, geographical, or other factors.

The Storage Sub-system

At all three sites examined, aboveground evidence of the storage subsystem is preserved in the form of ice house foundation walls (see FIGS. 12–14). Although differing in size, most ice houses had a similar basic structural configuration—a large barn-like building divided into smaller internal rooms, with large narrow vertical doors to permit loading and unloading of the ice. The preferred construction materials were spruce and white or yellow pine, selected because of their durability. As noted above, the exteriors were painted a brilliant white to reflect the sun's rays and retard melting (Hall 1884: 9–10; *Ice Trade Journal* 1882b: 1). None of the frame superstructures of the Hudson River ice houses have survived. What are left today are the stone foundations of the interior and exterior walls. Portions of the powerhouses that

Figure 15. The remains of foundation walls at Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House). The view is to the east.

adjoined the ice houses are also visible and these will be discussed below.

At Ice House Site C the present shoreline has undergone substantial erosion, resulting in the removal of the northernmost portion of the walls labeled A and B in Figure 14 and the westernmost portion of wall E, enabling us to view the construction of these foundations without excavation. Piles of stones representing the remains of portions of these walls are visible at low tide (FIG. 15). The dashed lines on the site plan indicate these remains. The exposed foundation walls are constructed of cut fieldstones set in mortar. Much of the mortar in the lower portion of the walls has been removed by erosion, however. The stone foundation walls are overlain by 2–3 courses of brick, considered to represent the upper portion of the foundation walls that served to support the frame superstructure walls of the ice house. It is this brick upper portion of the foundation walls that represents the visible portion of the remainder of the ice house walls. Probing at the location of the eroded portion of wall B at low tide encountered its base beneath a few inches of beach sand. The stone lower portion of the foundation wall at this location is 3.5 ft (1.1 m) high.

By comparing field measurements with the morphology of Ice House C as indicated by the documentary sources, we were able to determine that of the visible walls, all except wall D and the northern portion of Wall E, were associated with the original portion of the ice house constructed in the early 1880s. Wall D and the northern portion of Wall E were most likely added during the second enlargement of the ice house, which occurred between 1901 and 1905.

Documentary sources (Hall 1884: 10; Rothra 1988: 10) indicate that some ice houses were constructed with wooden flooring while others had merely an earthen floor. The very limited shovel testing that we conducted at Ice House Site C yielded evidence of neither. The documentary sources also indicate that ice houses were constructed with a system of drains to carry off the inevitable melt waters. More extensive excavations would most likely reveal the details of such systems.

Figure 16. Section of ornamental molding, apparently from the facade of the Ice House A (the J. Scott & Company Ice House) powerhouse.

Power-Generating Subsystem

At Ice House Sites A, B, and C, the remains of the power-generating subsystem are represented by powerhouse walls and foundations, supporting structures for coal-fired steam engines and power train components, and other features. These features provide insight into details of powerhouse construction and operation.

At Site A, we noted the presence of a section of ornamental limestone molding (FIG. 16). At the Nutten Hook Ice House site, the brick powerhouse had decorative elements on its exterior facade. The National Register of Historic Places nomination form for the latter site (NYOPRHP 1984: 2) described this ice house as "an exceptionally ornamented structure." It is likely that the decorative molding at Schodack-Houghtaling Island site A was similarly attached to the exterior of a brick powerhouse. Frame powerhouse structures, such as those assumed to have been present at sites B and C (see below) would not have been able to bear the weight of such stone decorative elements. Constructing the powerhouse walls of brick, while increasing the construction expense, would have lessened the danger of fire posed by the firebox/boiler system. The incorporation of decorative elements into the construction of the Nutten Hook and Schodack-Houghtaling Island Site A ice house facilities suggests that aesthetic considerations may have influenced the construction of some Hudson River ice houses.

A complex of remains representing the powerhouse and associated features was noted at the northeastern corner of the Ice House B foundation, corresponding with the powerhouse location as shown on the early 20th-century USACE maps (FIG. 9). The exterior limits of the powerhouse complex are defined by brick walls representing the powerhouse foundation. The floor of the powerhouse would appear to have been raised above the elevation of the surrounding terrain (FIG. 17). Four features associated with the powerhouse were noted. Three of these are located within its boundaries, and one immediately to its east. Feature A is a narrow brick structure measuring 20 ft (6.1 m) north-south and 9 ft (2.7 m) east-west, its southern end contiguous with the southern end of the brick platform (FIG. 18). The structure appears to have been open at its northern end and closed at its southern end. There is an approximately 19.5 in (49.5 cm) square opening in the western wall of Feature A (see FIG. 17). A metal lining within this opening would appear to have served as a frame for a small door or cover for the opening. A smaller (approximately 2 in [5 cm] diameter) opening lined with metal was noted in the eastern wall of Feature A. Three concrete machinery supports, designated as Features B–D, are located east of Feature A. Two are located within the boundaries of the brick platform and one (Feature D) immediately east of it. Threaded bolts used to attach machinery protrude from the top of these supports. Wooden beams on which machinery apparently rested remain intact atop Feature C.

The features observed at Ice House Site B most likely represent supports and structures

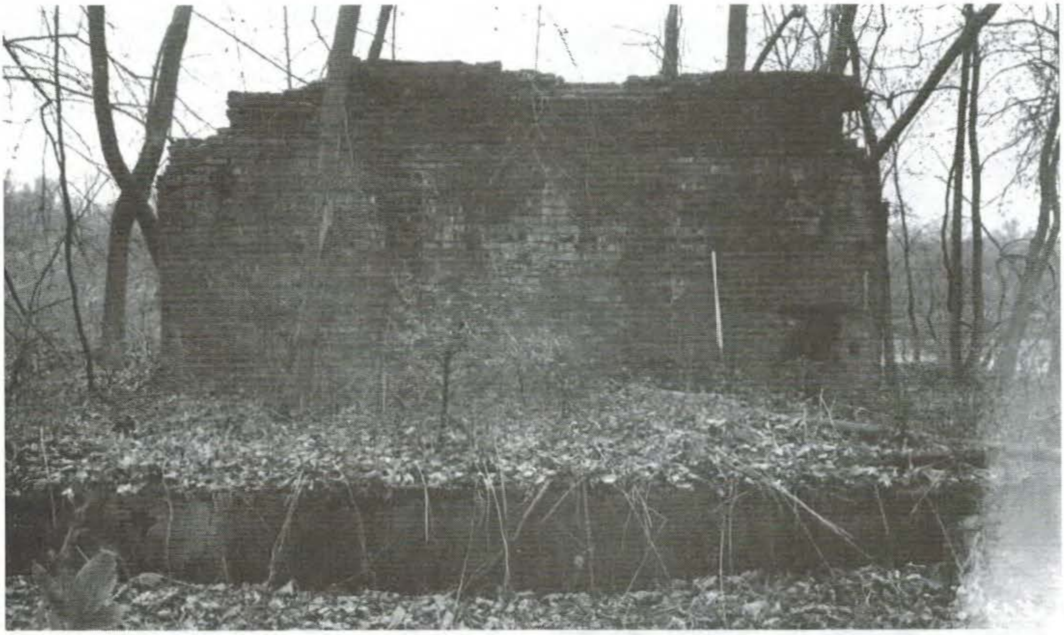

Figure 17. Remains of Ice House Site B (the P. McCabe & Co. Ice House) powerhouse. In the background is the narrow brick structure, designated Feature A, which may have housed the steam engine boiler and firebox. Coal was probably shoveled in through the opening visible at the right end of the structure's exterior wall. The view is towards the east.

Figure 18. This photograph shows the closed end of Feature A, located within the remains of the Ice House Site B (the P. McCabe & Co. Ice House) powerhouse. The narrow brick structure may have housed the steam engine boiler and firebox. The view is towards the north.

associated with the steam engine and power train, which supplied power to the ice house elevators and other machinery. The smaller brick enclosure (Feature A), which was located within the larger powerhouse, apparently housed the steam engine boiler and firebox. Such a structure may represent a solution to the fire danger posed by a boiler placed unprotected within a frame structure. The opening in the west wall of Feature A (FIG. 17) may have served to permit coal stored adjacent to it to be shoveled into the structure for use in the boiler. The steam engine itself may also have been located within Feature A. The size of this structure, however, suggests that the engine was probably located adjacent to it, and supported on Feature B and/or C. The opening in the east wall of the structure may have admitted a pipe or hose that transmitted the steam from the boiler to the engine.

At Site C, the powerhouse foundation walls, measuring approximately 22 × 30 ft (6.7 × 9.1 m) were noted adjacent to the western wall (Wall A) of the icehouse. The location of these foundation walls is consistent with that of the powerhouse as indicated on USACE maps (see, e.g., FIG. 10) as well as a late 19th/early 20th-century photograph (FIG. 11).

Four *in situ* features were noted within the area bounded by the powerhouse foundation walls. Feature C, in the southwestern corner of the structure, is a brick platform, the top of which is approximately 6 in (15 cm) above the powerhouse foundation walls and some 13–17 in (33–43 cm) above the adjacent earthen surface within the powerhouse foundation. At least one threaded bolt was noted protruding from the top of the platform. An iron grommet is also imbedded in its surface. This feature may represent a platform that supported the steam engine boiler. It is possible that the platform was enclosed by brick walls similar to those of Feature A at Ice House B, representing the same solution to the fire danger.

The two features labeled "B" on Figure 14, located in the northeastern portion of the structure, are two 3 ft × 3 ft (91 × 91 cm) brick machinery supports, each of which has four threaded bolts protruding from its upper surface. The remains of an additional machinery support (not shown on the site plan) that has been displaced from its original location was noted within the powerhouse walls. These features may have supported the engine and/or a portion of the power train that transmitted the power from it to the elevator machinery.

Feature A, located a few feet south of the northeastern corner of the brick platform, is a subterranean feature 3 ft (91 cm) in diameter and lined with dry-laid fieldstone. It apparently functioned as a well. A similar feature was noted at the Nutten Hook powerhouse site. The reason for the presence of a well inside the powerhouse is uncertain. It may have been used to provide water to fill the steam boiler and/or drinking water for the ice house workers. Although it would appear to have been simpler to pump water directly from the Hudson River, the location of the well within the powerhouse, where the temperature would have been higher, may have kept it from freezing during the winter. A worker's account of life on the ice fields in upstate New York notes that workers usually ate their lunch in the powerhouse because the operation of the steam engine created comfortable temperatures within the structure (Rothra 1988: 17). In addition, the river may have contained too much suspended silt to permit its water to be used without clogging the boiler and the associated piping, valves, and other components. Water pumped from the well would have been free of this suspended silt.

In a description of a Maine ice house, Everson (1970: 208) notes the presence of a privy within the powerhouse. The diameter of Feature A at the Van Orden, Vanderpool and Sherman site, however, would appear to be consistent with its identification as a well.

Many of the Hudson River powerhouses had smoke stacks constructed of brick. Surviving examples may still be seen at Scott's Ice House on Nutten Hook and at the Miller and Whitbeck Ice House, also located on Schodack-Houghtaling Island (Harris and Pickman 1999). No visible remains of brick stacks were found at Ice House Sites A, B, or C, however. Close examination of ice house photographs revealed that at some sites a vertical iron pipe was used to vent the smoke from the fire box (FIG. 19). In the case of site C, documentary evidence (Beecher 1988: 21–28; Sherman 1881) confirmed that an iron stack was, in fact, part of the original configuration of this facility.

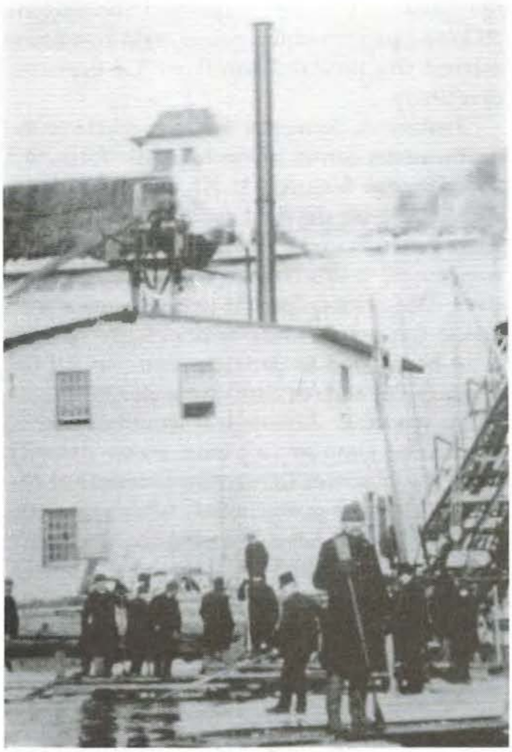

Figure 19. Many of the Hudson River ice house powerhouses had brick chimney stacks. Some, however, including Ice House Site C (the Van Orden, Vanderpool, & Sherman Ice House), used vertical iron pipes to vent the smoke. One of these iron stacks is visible atop the powerhouse in this undated photograph of the Greene and Bedell Ice House in Coxsackie, NY. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

Power Transmission/Ice House Loading and Unloading Subsystem

Prior to the availability of commercially feasible electrical motors and generators, power transmission from the powerhouse to the elevators would necessarily have been by means of mechanical systems utilizing a system of shafts linked by belting or gears. A 19th-century depiction (FIG. 20) shows what appears to be a shaft extending from either side of the powerhouse and connecting with a pulley at the side of each of the two elevators shown. This pulley was connected by a belt to another at the top of the elevator.

We have been unable to discern such power transmission systems in the photographs of the Hudson River ice houses that we have examined. Observation of the remains of the Nutten Hook powerhouse by the present authors and others (NYSOPRHP 1984) suggests that a shaft or belt passed through an opening in the rear wall of the powerhouse, which was separated from the front wall of the ice house by a space of only a few feet. It is possible that the usual practice was to route the power train from the powerhouse to the interior of the ice house and to extend the shafting/belting system within the structure to the locations of the elevators. This would have had the advantage of protecting the mechanical linkages from direct exposure to the elements.

Photographs indicate that there was substantial variation in the systems used for loading the 200–300 pound ice cakes into the ice house and subsequently unloading them into barges. Loading was accomplished by the use of one or more steam powered endless chain elevators. At the river end of the elevator a floating "apron" was used to enable the crew to load ice cakes onto the elevator regardless of the tidal level.

In a common configuration seen in drawings and prints a separate elevator is located in front of each ice house door (FIG. 21). The endless chain elevator hoisted the ice cakes up the inclined plane that formed the "floor" of the elevator. Trap doors were cut into the surface of this plane, each of which was positioned above one of the delivery runs that slanted downwards toward the door of the ice house. As the ice house was filled, the trap doors in the inclined plane would be opened and closed to enable the ice to be delivered to the interior of the house at the appropriate level. At some ice houses, possibly for reasons of economy, only a single, portable elevator was used. This device was moved from door to door to fill up the various rooms (Walsh 1983). This would explain the absence of elevators in photographs of some of the Hudson River ice houses. At Ice House C, two elevators were used, as shown in a turn-of-the-century photograph of this facility (FIG. 11). One served the original portion of the structure and the second, the ca. late 1890s extension.

Unloading of ice houses was accomplished using a system of wooden slides and/or by

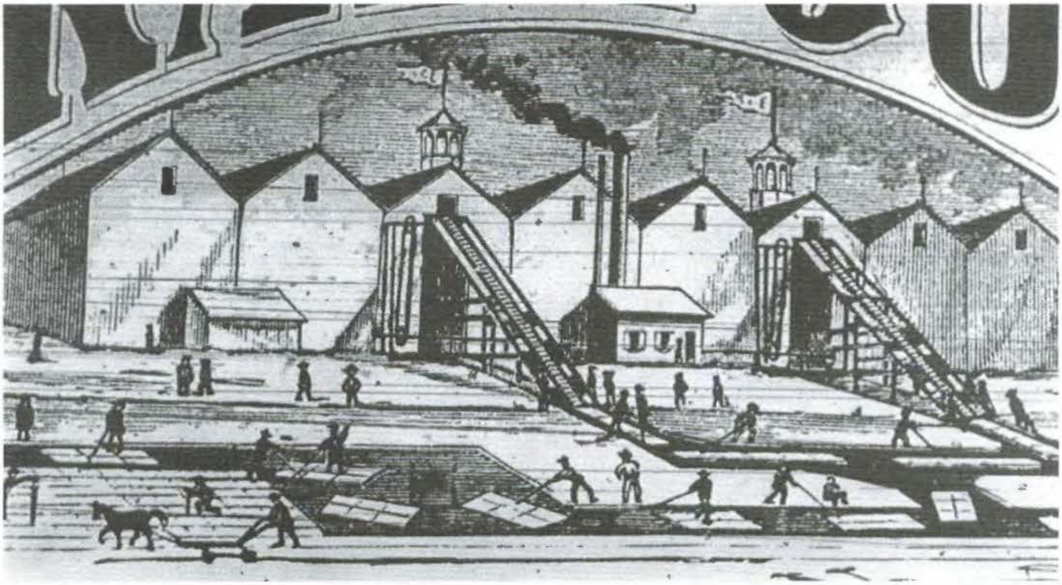

Figure 20. The power for the ice house elevators was transmitted from the powerhouse via mechanical systems that used a system of shafts linked by belting or gears. In this 19th-century depiction, shafts extend from either side of the powerhouse, connecting with a pulley at the side of each of the two elevators shown. Belts can be seen connecting to another pulley at the top of the elevator (*Ice Trade Journal* 1878: Masthead).

reversing the elevators. A wooden slide used to unload the ice at Ice House C is visible in the photograph, extending from the doorway immediately to the right of the powerhouse into the barge moored at the wharf (see FIG. 11). No aboveground remains of the loading/unloading system were noted at Site C.

Another type of system used to load ice houses consisted of a single elevator in conjunction with a system of slides or "runs" that extended along the front, or in some instances the sides of the ice house, leading to the various doors. Photographs suggest variations of this type of loading system. At some ice houses, fixed runs extended across the front and/or sides of the structure at different heights (FIG. 22). Other ice houses employed a moveable system in which a single "run" extended across the front of the ice house and was divided into a number of sections, each of which could be raised and lowered by a pulley system.

Although there are apparently no photographs or detailed maps of Ice House Site B, the visible remains suggest that this type of system was in use here. Remains of the loading/unloading system at this site are represented by a row of 13 3-ft (91-cm) wide supports constructed of brick covered with concrete. These supports, immediately adjacent to the east wall (Wall B) of the ice house are designated as Features E–Q on Figure 13.

Analysis of these features enables us to trace the history of the expansion of the ice house and to make inferences as to the type of loading/unloading system in use here. Eleven of the features can be divided into three groups, based on the spacing between them. The four northernmost (Features E–H) are 35 ft (10.7 m) apart, the supports in the second group (Features H–K) are separated by 28–29 ft (8.5–8.8 m), and those in the third group (Features L–O) are 30–31 ft (9.1–9.4 m) apart. There is a gap of some 81 ft (24.7 m) between the second and third groups.

Two of the 13 features, designated Features P and Q, do not fall within the three groupings noted above. The southernmost of the 13 features, Feature P, is located approximately 4 ft (1.2 m) south of the south wall of the ice house (wall B), and only 25 ft (7.6 m) south of Feature O. The support designated as Feature Q, located between features L and M, is longer

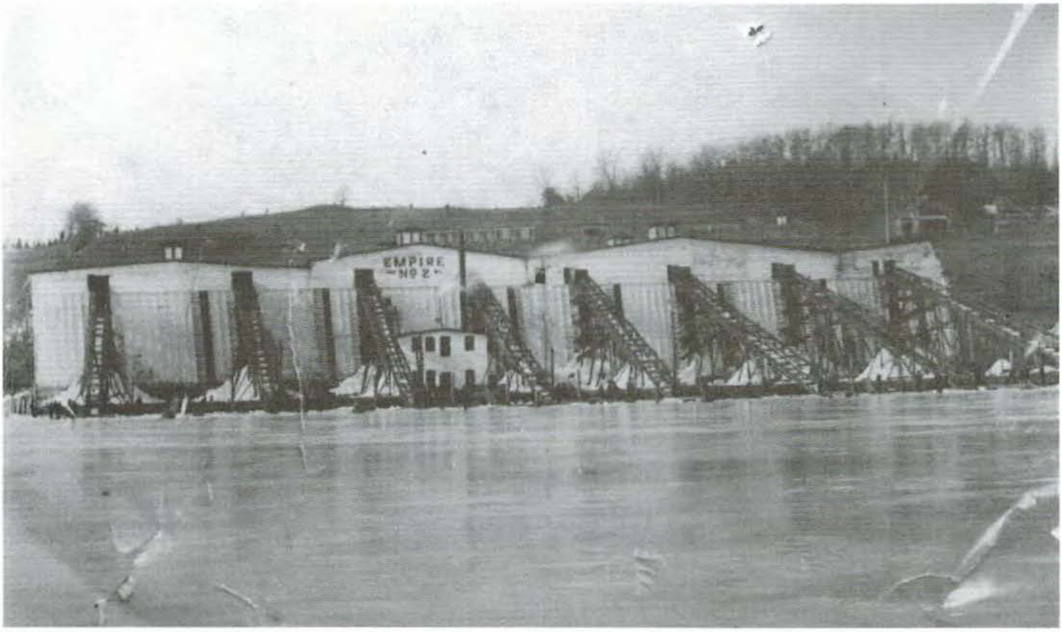

Figure 21. Substantial variation existed among Hudson River ice houses in the configuration of elevators used to load ice. Here, in an undated photograph of the Empire Number 2 Ice House at Catskill, NY, a separate elevator is located in front of each door. (Courtesy of the Vedder Memorial Library, Greene County Historical Society.)

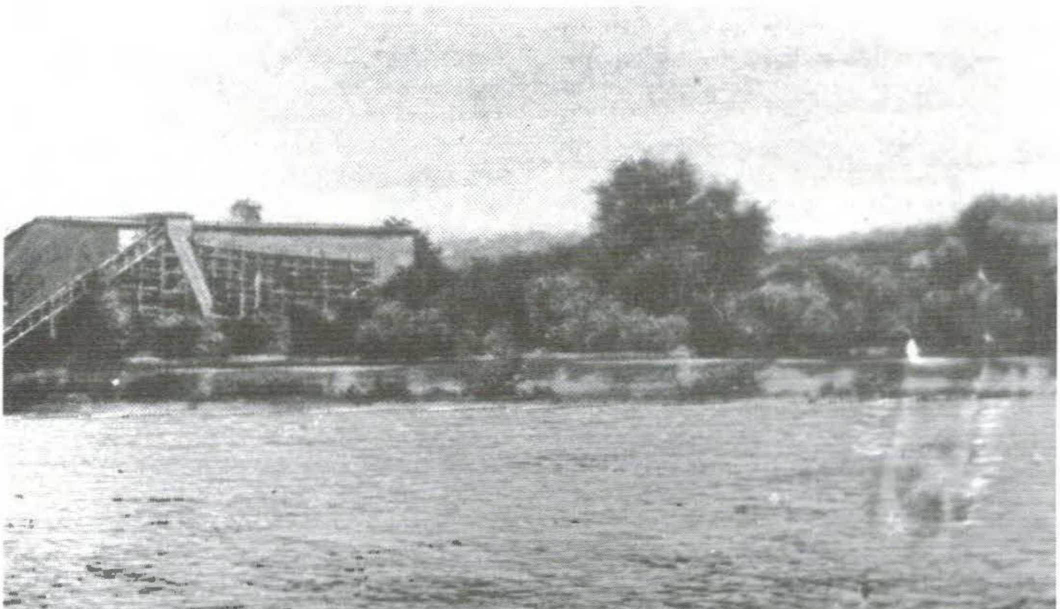

Figure 22. At some Hudson River ice houses loading systems consisted of a single elevator in conjunction with a system of "runs" extending along the front or sides. Here, at the Horton Ice House, located on Schodack-Houghtaling Island, runs extend along the front of the structure at different heights (Bruce 1903).

than the other 12 features and is slightly further from the ice house wall.

The interpretation of the function of Features E–P would depend on the type of system used at this facility to fill the ice house. If each of the large vertical loading doors at Ice House B had its own elevator, Features D and E–P may have served to support gearing that transferred power from a shaft exiting the powerhouse and extending eastward to a perpendicular shaft that ran along the front of the ice house and transmitted power to the various elevators. Such a shaft can be seen in a drawing of an ice house on the masthead of a trade publication, *Ice Trade Journal* (FIG. 20). As noted above, however, photographs of other Hudson River ice houses suggest that the shaft ran through the interior of the ice house.

If Ice House B employed a system of ramps across the front of the structure, Features E–P could represent the bases for vertical supports for the various sections of the ramps and/or machinery used to raise and lower them. Feature D may have functioned as part of the support for the ice house elevator. When the ice house was expanded, additional elevators may have been constructed. Feature Q could represent a support for one of these.

It is possible that the variations in the spacing between the machinery support bases along the eastern wall of the ice house are associated with successive expansions of the facility. This inference is consistent with the increase in capacity of the ice house as indicated by the documentary evidence (see TAB. 1).

The documentary sources also indicate that Ice Houses B and C were constructed with similar capacities (see TAB. 1). The length of the ice house wall (approximately 110–115 ft) (33.5–35.1 m) in front of the northernmost group of Ice House B features (Features E–H) and the width of the structure as indicated by documentary sources are similar to the 100 × 150 ft (30.5 × 45.7 m) dimensions, as originally constructed, of Ice House C. This suggests that this first group of features, located closest to the powerhouse, was associated with the original 1881 construction of Ice House B.

The first expansion of Ice House B in 1884–1885 resulted in a doubling of its capacity from approximately 10,000 to 20,000 tons (see TAB. 1). The field measurements, which indicate that Feature K is some 202 ft (61.6 m) from the northern end of the ice house, suggest that construction of the second group of support bases (Features I–K) was associated with an approximate doubling of the length of the ice house, suggesting that these features were constructed in 1884–1885.

Similarly, the capacity of Ice House B was again approximately doubled by 1901. This corresponds with a doubling of the structure's length from approximately 200 ft (61 m), at the location of Feature K, to the overall length of 400 ft (121. 9 m), as measured in the field. This suggests that the southernmost group of support bases was associated with this second expansion of the ice house.

Transportation Subsystem

Wharves

At all three sites the most visible remains of the facilities associated with the transportation of the ice to market are the wharves that once permitted the loading of ice barges. Although erosion has removed portions of each wharf, a combination of documentary and field evidence has allowed us to reconstruct their original appearance. Typically, the wharves were positioned immediately in front of each ice house, jutting into the river to form a three-sided enclosure. This configuration can be clearly seen on maps showing Ice Houses B and C (FIGS. 9–10), their lateral extent corresponding almost exactly to that of the ice house. At Ice House A, the wharf occupied the shoreline of a cove at the north end of the site, as well as the portion of the Schodack Channel shoreline in front of the ice house (see FIG. 8). As seen at all of the sites, the exterior bulkhead walls of the wharves consist of double rows of wooden pilings with horizontal stringers. The wharves were created by filling in the space between the original shoreline and the bulkhead walls with river cobbles and gravel.

At Ice House Site C, ca. 1880s plans depict a proposed wharf extending along the shoreline the full length of the ice house. At the approximate location of the southern end of the wharf as shown on the plans and the 1897

USACE map (FIG. 10), we noted a row of pilings extending into the river. These are depicted in Figure 14 as Feature D. Records indicate that the original pilings were oak and were replaced four years after the wharf was constructed (Beecher 1988: 26). Additional pilings noted along the shoreline of the small cove immediately south of the site, depicted in Figure 14 as Feature E, suggest that additional wharfage was added in order to accommodate the southern extension of the ice house at the end of the 19th century.

At Ice House Site B, remains of concrete paving were noted on the surface adjacent to the top of the wooden bulkhead, and it is possible that the entire surface of the wharf was paved. A circular opening noted in the concrete at one location may have served to accommodate a mooring post for ice barges.

Barges

At Ice House Sites A and B, the remains of five wooden barges also survive. The best preserved is a vessel located to the north of Ice House Site A's wharf (FIG. 23). The vessel measures 100 ft (30.5 m) in length and 25 ft (7.6 m) in width. Much of the lower portion of its hull, including the bow and stern, remains intact, resting upon and buried in the river silts. Although the hull's lower planking is partially covered with silt, portions of its internal framing are visible. A series of eight upright supports are attached by brackets to a center beam or keelson. The uprights are approximately 11 ft (3.4 m) apart—those that are intact measuring approximately 11 ft (3.4 m) in height. The iron bales topping the uprights supported transverse beams, one of which is still present. The deck planking would have been attached to these beams.

Other potentially significant details of this vessel include layers of transverse planking in the vessel's hull, longitudinal beams separating the two observed layers, a slight curvature evident in the framing of the vessel's bow, and the absence of cross-bracing in the hull's interior (Norman Brouwer, personal communication 1998; Mark Peckham, personal communication, 1998).

We have assumed that this vessel was employed in the transport of ice from Schodack-Houghtaling Island to New York City and other markets. Documentary evidence and details of its construction suggest a number of possible vessel-type identifications.

The standard ice barge was fitted specifically for the trade. A drawing of this vessel type appears in Figure 24. Many were built in local Hudson River shipyards including those at Athens, Hudson, and New Baltimore. In the mid-1880s, the river's ice barge fleet numbered about 100 vessels. In the spring and summer months, they traveled down the river in groups of 6 to 12, guided by tugs belonging to the ice companies. Their destinations included depots in Brooklyn, Manhattan, and Yonkers where the ice was unloaded at the docks, as depicted in Figure 25, and distributed throughout the metropolitan region (Beers 1884: 373; Hall 1884: 17).

Although flat bottomed and designed for shallow waters, ice barges were capable of carrying from 400–800 tons of ice. They typically ranged in size from 110 ft (33.5 m) in length, 26 ft (7.9 m) in width, and 9 ft (2.7 m) in depth to approximately 140 ft (42.7 m) in length, 34 ft (10.4 m) in width, and 10 ft (3 m) in depth of hold. Their construction included white oak frames, yellow pine planking and decking, and white pine housing. A series of approximately three to five tall masts, each measuring approximately 30 ft (9.1 m) in height, lined the deck and were designed to act as derricks for loading and unloading the cargo.

Sources suggest that the ice was stored in the barge's hold or in a long, double-walled and insulated deckhouse or cargohouse (Hall 1884: 17; Walsh 1983). One ice industry historian describes the barges as

> somewhat like a floating box. The ice would be loaded on the inside of the box—the barge's hold—so that as much of the barge as possible, when loaded, would be set low in the water to use the lower river temperature to keep the ice melting to a minimum. (Clark n.d.: 285)

Once the hold was filled, additional ice could be stored in the deckhouse, which was topped by a small pilothouse. The barge captain's accommodations were provided in the pilothouse, enginehouse, or at one end of the deckhouse. Canvas-bladed revolving wind-

Figure 23. Remains of a wooden barge located near Ice House A (the J. Scott & Company Ice House). A series of upright supports can be seen, attached to the center beam or keelson, which is buried in river silts. The iron bales topping the uprights supported transverse beams, one of which is still present. Deck planking would have been attached to these beams. The view is towards the north.

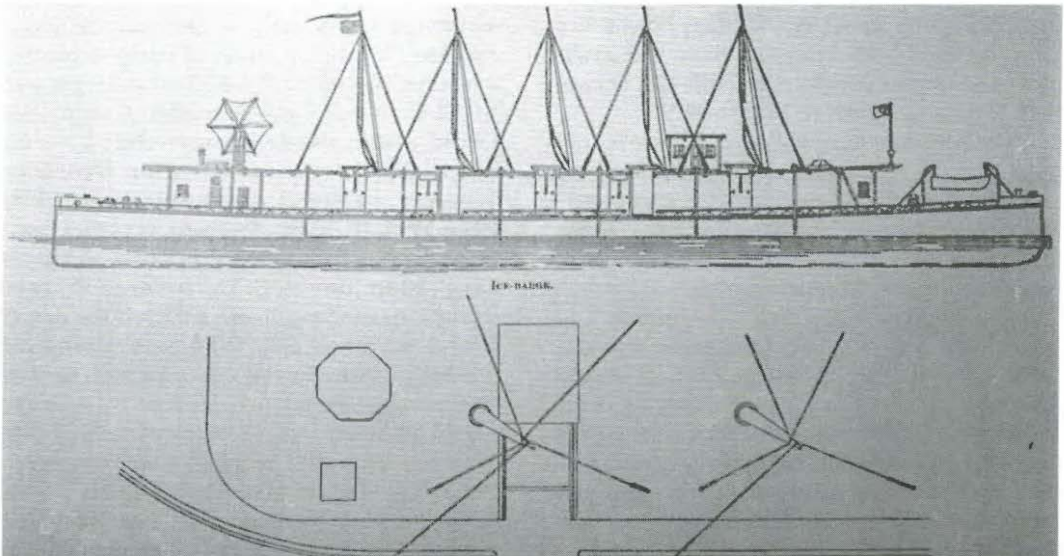

Figure 24. This drawing, taken from Hall 1884, shows a standard ice barge. These vessels were capable of carrying between 400 and 800 tons of ice. Seen above the deckhouse are masts designed to act as derricks for loading and unloading ice. Next to the derricks is a canvas-bladed windmill, powering bilge pumps in the hull that controlled melting ice water.

Figure 25. During the spring and summer months ice was shipped down the Hudson River in fleets of ice barges to various depots in Brooklyn, Manhattan, and Yonkers. This engraving, reprinted from an 1884 *Harper's Weekly*, shows ice being unloaded at a New York City dock. (*The New York Chronicle* 1993: cover illustration. Courtesy of the South Street Seaport Museum Library.)

mills were also located above the deckhouse, powering bilge pumps in the hull that controlled melting ice water. Thomas Edison has been credited with inventing these windmill-powered pumps (deNoyelles 1982: 138; Dibner n.d: 17–20; Hall 1884: 17; Walsh 1983).

The length of the Ice House A vessel's hull (100 ft) (30.5 m) and its slightly curving bow suggest that it may be a shorter and blunt-bowed version of the standard ice barge described above. An undated photograph in the South Street Seaport Library's collection depicts vessels fitting this description, and possessing only three derricks and one windmill (FIG. 26). The Ice House A barge would probably not have had a cargo-carrying deckhouse, however, since examination of the remains indicates that the vessel's hull lacked the cross-bracing necessary to provide the structural strength to support such a deckhouse as well as the pilot house that topped it.

Alternatively, it has been suggested that the vessel represents a wooden covered barge (a type also referred to as a "covered lighter" or "transfer barge") adapted for the ice industry. Such vessels were commonly used in New York harbor from the second half of the late 19th century until the 1950s to carry perishable freight. Comprising a rectangular wooden scow hull with a deck that carried a wooden "house," a covered barge typically measured 90–100 ft (27.4–30.5 m) in length and 30–32 ft (9.1–9.8 m) in width. Cargo was placed within the deckhouse while the hull functioned solely for flotation (Norman Brouwer, personal communication, 1998; Flagg 1997: 10; Mark Peckham, personal communication, 1998). Several recordation efforts have been devoted to covered barges (Panamerican Consultants 1997). If the Site A vessel were of this type, the abundant planking within the bottom of its hull, as well as the slight curvature evident in its bow, would indicate a ca. 1890s construction date (Norman Brouwer, personal communication, 1998). The absence of structural supports for a cargo-carrying deckhouse would also argue against identification of the Ice House A barge as being of this type, however.

Finally, the Ice House A vessel's dimensions and internal framing indicate that it may be a coal barge. These vessels lacked a deckhouse, and thus carried all their cargo within the hull. If adapted to the ice trade, this type

Figure 26. An undated photograph shows a group of ice barges belonging to the Rockland Lake Ice Company. These are shorter and more blunt-bowed than the standard ice barge shown in Figure 24, and have only three derricks. (Courtesy of the South Street Seaport Museum Library.)

of vessel would have carried ice below deck. Details noted in the field, including the vessel's width and length, the height of the uprights, and the absence of cross-bracing, accord well with drawings of a typical coal barge (see FIGS. 27a, 27b). Additional investigations, centering upon various aspects of the vessel's construction, may provide a more definitive identification. A more complete recording of the hull would be possible if the river silts that at present cover it were to be removed. Investigations focusing upon the hull's center keelson might reveal whether any remains of the distinctive ice barge pumping mechanism survive (Norman Brouwer, personal communication, 1998).

Conclusion

Upon hearing that we were studying Hudson River ice harvesting, a colleague commented that it seemed like an unlikely undertaking for students of material culture—to study a process that produced a commodity that was both transparent and impermanent—a substance that literally melted away leaving no traces. Unlike iron manufacturing, brick-making, quarrying, lumbering, and other 19th-century industries associated with the Hudson River, the products and byproducts of ice harvesting are not to be found in the archaeological record. As archaeologists, we are accustomed to retrieving material evidence of the outcome of a productive process—artifacts that can be examined and categorized by type or period of manufacture. This is not the case with ice, a product that vanished within one or two seasons of its removal from the river.

Today, the built environment of this industry survives in the form of structural ruins, rusting hardware, and scuttled barges that remain as highly visible reminders of the Hudson River's industrial past. As indicated in aerial photographs of the Hudson shoreline, the former ice house wharves also survive as embedded features of the riverine landscape (FIG. 28). With the passage of time, however, development of the area will undoubtedly result in the destruction of many of these sites. Like the commodity they processed, the ice house remains are ultimately ephemeral, and unless recorded by archaeologists, the sites and the information they contain will be lost forever.

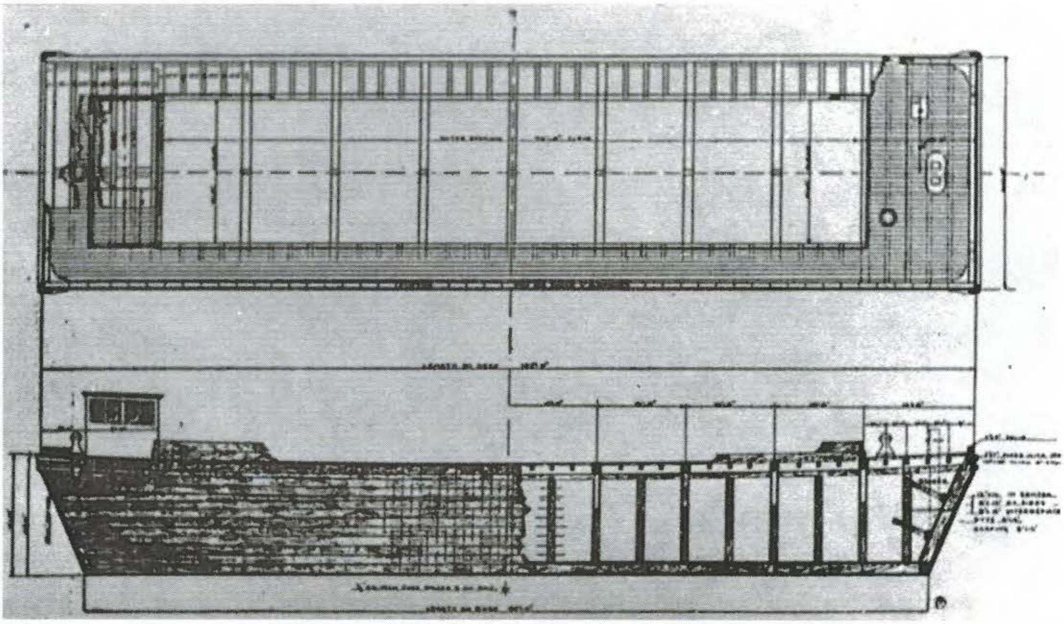

Figure 27a. Construction details suggest that the vessel located at Ice House A may be a coal barge that was adapted to the ice trade. This early 20th-century drawing shows a coal barge in plan view and profile. Lacking a deckhouse, a vessel such as this would have carried ice below deck (Anonymous 1903: 244. Courtesy of the Southport Museum Library.)

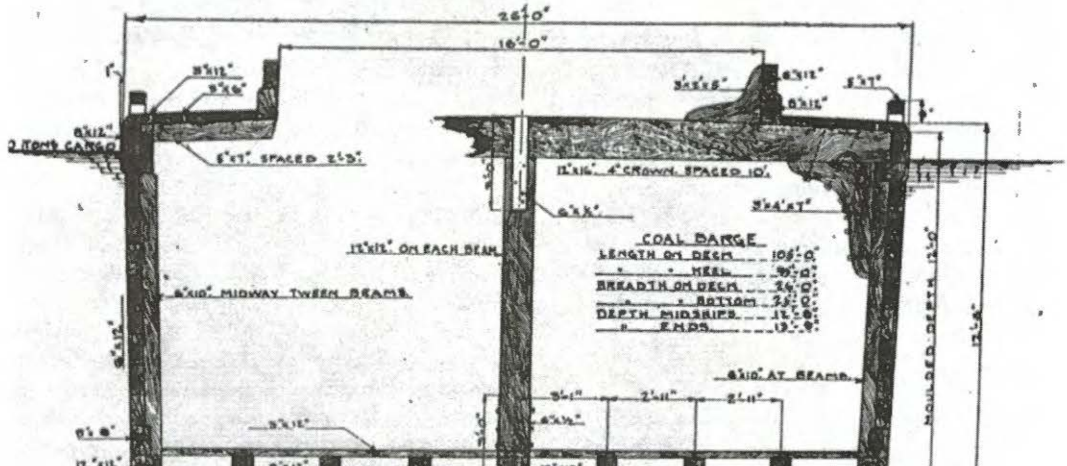

Figure 27b. Early 20th-century cross-section drawing of a coal barge (Anonymous 1903: 243. Courtesy of the South Street Seaport Museum Library.)

Figure 28. An aerial photograph of the Hudson River's western shoreline clearly indicates the locations of former ice house wharves. These remains survive as features embedded in the riverine landscape. (Col-East Inc. 1989. Scale of original: 1 in = 480 ft [1 cm = 57.6 m].

Suggestions for Future Research

The USACE project at Schodack-Houghtaling Island has given us an opportunity to assess what aspects of the Hudson River ice industry's history can be reconstructed through archaeological research. Based on the research described in this article, we believe that many Hudson River ice house sites contain material evidence that can be used to investigate poorly documented technological processes as well as the workplace culture of the region's emerging rural working class.

Given the present level of knowledge, we believe that the most effective approach to reconstructing and interpreting ice-harvesting technology is one that applies the framework developed here—focusing upon the explication of the four production subsystem elements—to the remains existing at ice house complex sites. While documentation and interpretation of visible remains represents a first step toward these ends, a more complete analysis would result from subsurface investigations. This would involve the use of mechanical equipment to remove the large amounts of sediment that have accumulated as a result of flooding or dredging.

The results of our investigations suggest several particular objectives of future field research. For example, in gathering data pertaining to the power-generating subsystem, archaeologists could focus their field efforts upon the interiors of the former powerhouses in order to identify and further explore the function of subterranean features such as those noted at Ice House Site C and at the ice house at Nutten Hook, which we have tentatively identified as wells. We have also suggested that considerable variation existed in the ice house loading/unloading subsystems. Data generated through archaeological excavation, such as the arrangement and morphology of the features tentatively identified as machinery and structural supports, as well as the recovery of artifacts representing hardware employed in the power transmission system, may provide clues as to the types of systems used at a particular facility.

By directing documentary research and fieldwork towards an understanding of how each distinct subsystem operated at several individual ice house sites, and comparing differences and similarities in their configurations, we can begin to fill in the gaps in our understanding of ice house technology.

Another important category of ice industry remains consists of the artifacts left behind by ice house workers. Research suggests that some ice house complexes included workers' boardinghouses. Excavations at such sites could confirm the presence of these structures and investigate their configurations and dimensions, which in turn would provide an indication of the number of resident employees. Archaeological fieldwork at such sites could also encounter domestic deposits that would broaden our understanding of daily life in the ice fields.

As discussed above, there has been little research into the formation of the region's rural working class. Living in sparsely populated areas, far from the reach of social institutions, owning little land if any at all, often self-employed and engaging in seasonal occupations, the lives of this group tend to be poorly chronicled in the written record. Ice house workers, however, because their labor was so critical to the region's economy, are more visible and thus are mentioned more frequently in newspapers and other documentary sources. We know, for example, that the composition of the ice industry labor force was diverse in its class and ethnic origins. Because such variation is often expressed in the archaeological record, domestic deposits encountered within ice house sites may provide clues as to the extent to which workers were drawn from the ranks of local farmers and artisans or from a less economically secure group of transient laborers, as well as the relative percentages of immigrant to native born workers.

Acknowledgments

We are grateful for the assistance we received during the preparation of this article. We would like to thank the following: Norman Brouwer, South Street Seaport Museum, New York, New York; Cynthia Blakemore, Mark Peckham, and Paul R. Huey, New York State Office of Parks, Recreation and Historic Preservation, Waterford, New York; Raymond Beecher, Shirley McGrath, Louise Messinger, and Judith Rundell, Vedder Memorial Library, Greene County Historical Society, Coxsackie, New York; Helen McLallen, Columbia County Historical Society, Kinderhook, New York; Dave Smalley, Stuyvesant, New York; Chris Pyslopski, Palisades Interstate Park Commission, Bear Mountain, New York; Irene Saganich, Mary Bol, and the members of the Esquatak Historical Society, Castleton, New York; Ann K. Legenbauer and the members of the Poestenkill Historical Society, Poestenkill, New York; William F. Petronis, Daniel Karlok, Marc Forstell, and Richard Campbell, Albany Field Office, Operations Division, New York District Corps of Engineers, Troy, New York; Nancy Brighton, Eugene Brickman, Jeffrey Cusano, Jeffrey Fry, Roselle Henn, Nikoleta Katsakiori, Dag Madara, Lynn Rakos, and Joseph Vietri of Planning Division, New York District Corps of Engineers, New York City; and Peter Shugert and David York of the Public Affairs Office, New York District Corps of Engineers, New York City. We especially wish to thank the staff of *Northeast Historical Archaeology*, including Mary Beaudry and Stephen Brighton, and two anonymous reviewers. Their feedback, comments, and suggestions gave us new perspectives on our research and writing. Much of the research for this article was funded by the New York District Corps of Engineers, which does not necessarily agree with the all the conclusions cited above or bear any responsibility for them.

References

Anonymous
1903 Barge Construction. *The Nautical Gazette.* October 8, 1903: 243–244. Vertical Files, Library of the South Street Seaport Museum.

Beecher, Raymond
1979 A Winter's Ice Harvest, 1900–1901. Greene County *Historical Society Journal* 3(4): 1–3.
1988 The Shermans of New Baltimore: The Fourth Generation's Augustus Sherman. *Greene County Historical Society Journal* 12(3): 21–28.
1991 *Under Three Flags: A Hudson River History.* Black Dome Press, Hendersonville, NY.

Beers, F. W.
1891 *Atlas of the Hudson River Valley from New York City to Troy.* Watson & Co., New York.

Beers, J. B. & Co.
1884 *History of Greene County, New York.* 1969 reprint ed. Hope Farm Press, Cornwallville, NY.

Bruce, Wallace
1888 *Panorama of the Hudson River Showing Both Sides of the River from New York to Albany.* Photograph by G.Willard Shear. Bryant Literary Union, New York.
1903 *Panorama of the Hudson River Showing Both Sides of the River from New York to Albany.* Photograph by G. Willard Shear. Bryant Literary Union, New York.

Catskill Examiner
1875 The Strike. January. Ice Industry Folder,

Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1876 The Ice Business. n.d. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1877 The Ice Harvest. 23 January. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1878 The Ice Harvest. 23 February. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1879 The Ice Harvest. 18 January. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1880 The Ice Harvest. 24 January. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1883a The Ice Harvest. 20 January. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

1883b The Ice Harvest. 27 January. Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

Clark, Robert T.

n.d. Ice Harvesting: Working on the Ice. Article on file, Ice Industry Folder, Vertical Files, Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

Coeymans Herald

1879 The Meeting of the Workingmen. 18 June. New York State Library, Albany, NY.

1880 New Baltimore. 13 October. New York State Library, Albany, NY.

1881a New Baltimore. 12 January. New York State Library, Albany, NY.

1881b New Baltimore. 26 January. New York State Library, Albany, NY.

1881c Local Brevities. 20 July. New York State Library, Albany, NY.

1882 Coeymans. 15 June. New York State Library, Albany, NY.

Cold Storage and Ice Trade Journal

1905 Hudson River Harvest for 1905. 29(3): 72–73.

1910 Hudson River Harvest, Season 1909-1910. 39(3): 79–81.

Col-East Inc., North Adams, MA

1989 Aerial Photograph Series of the Hudson River. April 20.

Cummings, Richard

1949 *The American Ice Harvests*. University of California Press, Berkeley.

deNoyelles, Daniel

1982 *Within These Gates*. Privately published.

Dibner, Brent

n.d. The Other End of the Hawser: The History and Technology of the Barges That Tugs Towed...Cold Cargoes.... *Tugbitts: The Quarterly Journal of the Tugboat Enthusiasts Society of the Americas*. South Street Seaport Library Vertical Files.

Evers, Alf

1972 *The Catskills: From Wilderness to Woodstock*. Doubleday and Company, Garden City, NY.

Everson, Jennie G.

1970 *Tidewater Ice of the Kennebec River*. Maine Heritage Series, Maine State Museum, Freeport.

Fried, Marc

1995 *The Huckleberry Pickers: A Raucous History of the Shawangunk Mountains*. Black Dome Press, Hendersonville, NY.

Flagg, Thomas

1997 The Railroad Navy at the Port of New York, Part III: The Covered Barge. *Transfer: Newsletter of the Rail-Marine Information Group* 22: 10–15.

Gutman, Herbert G.

1977 *Work, Culture, and Society in Industrializing America*. Vintage Books, Random House, New York.

Hall, Henry

1884 The Ice Industry of the United States. *Tenth U.S. Census*, 1880, Volume 22. U.S. Census Office, Washington, DC.

Harris, Wendy Elizabeth, and Arnold Pickman

1996 Engineering the Hudson: The Creation of an Historic Landscape. Paper presented at the Society for Historical Archaeology 29th Annual Conference on Historical and Underwater Archaeology, January 3–7, Cincinnati, OH.

1997 Waterways as Industrial Landscapes: The Engineering of the Hudson, 1797 to the Present. Paper presented at the Society for Historical Archaeology 30th Annual Conference on Historical and Underwater Archaeology, January 8–12, Corpus Christi, TX.

1999 Cultural Resources Investigation, Ice Harvesting Industry Remains Located on Property Belonging to the U.S. Army Corps of Engineers, New York District, Schodack-Houghtaling Island, Town of New Baltimore, Greene County, New York. Prepared for New York District Army Corps of Engineers. On file New York District Army Corps of Engineers and New York State Office of Parks, Recreation and Historic Preservation, Waterford.

2000 Feasibility Phase Cultural Resources Investigation, Hudson River Habitat Restoration Project, Greene, Columbia, and Putnam Counties, New York. Prepared for New York District Army Corps of Engineers. On file, New York District Army Corps of Engineers and New York State Office of Parks, Recreation and Historic Preservation, Waterford.

Harris, Wendy Elizabeth, Arnold Pickman, and Nan Rothschild

1996 Landscape, Land Use, and the Iconography of Space in the Hudson River Valley: From Prehistory to the Present. Paper presented at the New York Academy of Sciences, December 9, New York.

Huey, Paul R.

1992-1993 The Mahicans, the Dutch, and the Schodack Islands in the 17th and 18th Centuries. *Northeast Historical Archaeology* 21/22: 96–118.

1998 Historical and Archaeological Resources of Castleton Island State Park, Towns of Stuyvesant, Columbia County, New Baltimore, Greene County, and Schodack, Rensselaer County, New York: A Preliminary Phase I Cultural Resources Assessment. New York State Office of Parks, Recreation and Historic Preservation, Waterford.

Ice Trade Journal

1878 Masthead. 2(5): 1.

1881 Gleanings from our Correspondence. 4(9): 2.

1882a Ice Crop of The Hudson River. 5(9): 2 [April].

1882b How to Build Ice Houses. 6(4): 1–2.

1883a Gleanings from our Correspondence. 6(8): 2–3.

1883b Ice Trade on the Hudson. 6(10): 1.

1884 Gleanings from our Correspondence. 7(8): 1–2.

1885 Gleanings from our Correspondence. 8(9): 1–3.

1886 Ice Put Up On Hudson River and Vicinity. 9(9): 2.

1897 Ice Put Up on the Mohawk and Hudson Rivers and Vicinity. 20 (9): 8.

1901 Hudson River Crop. 25(9): 14–15.

Ingersoll, Ernest

1893 *Illustrated Guide to the Hudson River and Catskill Mountains.* Rand, McNally and Company, Chicago and New York.

Jones, Joseph C.

1984 *America's Icemen: An Illustrated History of the United States Ice Industry Trade, 1665–1925.* Jobeco Books, Humble, TX.

Lant, J. H.

1892 *Greene County Directory for 1892: Containing the Names of the Inhabitants of Catskill and Coxsackie.* Bryan & Wren, Hudson, NY.

Lenik, Edward J.

1992 Lumbering in the Highlands. *The North Jersey Highlander, Publication of the North Jersey Highlands Historical Society* 82: 1–6.

Maclay, Robert

1895 *The Ice Industry.* In *One Hundred Years of American Commerce,* Vol. II, ed. Chauncey Depew, 466–469. D. O. Haynes and Company, New York.

The New York Chronicle

1993 Cover Illustration: Bringing Ice to New York City in 1884. Volume 6(2). Reprinted from *Harper's Weekly,* August 30, 1884. Vertical Files, Library of the South Street Seaport Museum.

New York State

1892 State Census Records for Greene County, New York. Microfilm copy in collection of Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP)

1984 National Register of Historic Places Inventory—Nomination Form for R. and W. Scott Ice Company Powerhouse and Ice House Site, River Road, Stuyvesant, New York (Nutten Hook). Prepared by Neil

Larsen, submitted to Julia S. Stokes, Deputy Commissioner for Historic Preservation, Albany.

Panamerican Consultants
1997 Cultural Resources Survey, New York Harbor Collection and Removal of Drift Project, Arthur Kill, New York Reach; Arthur Kill, New Jersey Reach; and Kill Van Kull, New York Reach. Volume I, Revised Draft Report. Prepared for U.S. Army Corps of Engineers, New York District, New York.

Paul, Evelyn B.
1976 The Ice Industry in New Baltimore. In *The Heritage of New Baltimore*, ed. by the Bicentennial Committee of New Baltimore, 103–104. Heritage Committee of the Bicentennial Committee of New Baltimore, New Baltimore, NY.

Post, Paul
n.d. Ice Harvesting, A Once Important Area Industry. Clipping in Ice Industry Folder, Vertical Files. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

Refrigerating World Incorporating Cold Storage & Ice Trade Journal
1915 Hudson River Harvest 1914–1915. 49(3): 47.

Revkin, Andrew C.
1996 Life's Hubub Returns to Oft-Shunned Hudson. *The New York Times*, June 10, 1996: 1, 86–87.

Rothra, Willis H.
1988 *Two in a Bucket: A Personal Account of Ice Harvesting*. Rev. ed. Published by the Author. Printed by Overlake Enterprises, Stowe, NY.

Samuel, Raphael
1975 *Village Life and Labor*. History Workshop Series. Routledge and Kegan Paul, London.

Sharples, Stephen
1907 Nathaniel Jarvis Wyeth. *Cambridge Historical Society Publications* 2: 33–38.

Sherman, Augustus
1881 Receipt from Sullivan and Rice Iron works dated November 30, Edward Ely Sherman Memorial Collection, Box 147. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1882 Notebooks. Entry for January 27, 1882. Edward Ely Sherman Memorial Collection, Box 147. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1889a Notebooks. Entry for February 4, 1889. Edward Ely Sherman Memorial Collection, Box 147. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1889b Ice House Account Book. Amounts paid February 22, 1889. Edward Ely Sherman Memorial Collection, Box 138. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1889c Ice House Account Book. Amounts paid March 2, 1889. Edward Ely Sherman Memorial Collection, Box 138. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1895 Notebooks. Entry for January 5, 1895. Edward Ely Sherman Memorial Collection, Box 147. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.
1896 Notebooks. Entry for September 8, 1896. Edward Ely Sherman Memorial Collection, Box 147. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

Smith, Patrick
1996 Heart of the Hudson. *The National Geographic*, March 1996: 72–95.

Smith, Philip Chadwick Foster
1961 Crystal Blocks of Yankee Coldness. *Essex Institute Historical Collections* 97(3): 197–232.

Snyder, Bradley, and Karl Beard
1981 *The Shawangunk Mountains: A History of Nature and Man*. Mohonk Preserve, New Paltz, NY.

Spann, Edward K.
1981 *The New Metropolis, New York City, 1840–1857*. Columbia University Press, New York.

Stevens, William K.
1996 Shaking off Man's Taint, Hudson Pulses

with Life. *The New York Times*, June 9, 1996: 1, 46–47.

Stott, Peter
1979 The Knickerbocker Ice Company and Inclined Railway. *IA, The Journal of the Society for Industrial Archeology* 5(1): 7–18.

United States Army Corps of Engineers (USACE), New York District
1897 Improvement of the Hudson River, New York, in charge of Lieut. Col. William Ludlow and Major A. N. Miller, Corps of Engineers, U.S.A. Map on file U.S. Army Corps of Engineers, New York District, Albany Field Office, Troy, NY.
1915 Improvement of the Hudson River. Map on file U.S. Army Corps of Engineers, New York District, Albany Field Office, Troy, NY.
1929 Improvement of the Hudson River. Maps on file U.S. Army Corps of Engineers, New York District, Albany Field Office, Troy, NY.
1935 Improvement of the Hudson River. Maps on file U.S. Army Corps of Engineers, New York District, Albany Field Office, Troy, NY.

United States Geological Survey, Department of Interior
1953a Delmar Quadrangle, New York. 7.5 Minute Series (Topographic), Photorevised 1980. Digital Raster Graphic (DRG) File 1998.
1953b Hudson North Quadrangle. 7.5 Minute Series (Topographic), Photorevised 1980. Digital Raster Graphic (DRG) File 1998.
1953c Hudson South Quadrangle. 7.5 Minute Series (Topographic), Photorevised 1980. Digital Raster Graphic (DRG) File 1998.
1953d Ravena Quadrangle, New York, 7.5 Minute (Topographic), Scale 1: 24,000. Digital Raster Graphic (DRG) File 1998.

Vanderpool, Andrew V. S., Edward H. Van Orden, Augustus Sherman, James H. Hyer, and William H. Watson.
1896 Agreement dated March 28, 1896. Edward Ely Sherman Memorial Collection, Box 137. Greene County Historical Society, Vedder Memorial Library, Coxsackie, NY.

Walsh, Alice
1983 Ice Harvesting on the Hudson River. Articles appearing in the *Chatham Courier*, Chatham, New York, March 3 and March 10.

Wendy Elizabeth Harris is an archaeological consultant based in New York City and Ulster County, New York. She is a partner in Cragsmoor Consultants and was formerly the Senior Archaeologist at the New York District, Army Corps of Engineers.

Arnold Pickman is an archaeological consultant based in New York City. He is also a partner in Cragsmoor Consultants, an Ulster County, New York, archaeological consulting firm.

Wendy E. Harris
P. O. Box 327, Circle Road
Cragsmoor, N.Y. 12420
cragscons@aol.com

Arnold Pickman
150 East 56th Street
New York, N.Y. 10022
cragscons@aol.com