Introduction

For most people, the name Vermont is synonymous with a rolling landscape of cultivated fields and forests punctuated by small villages complete with town hall, church, general store, and white clapboard homes. Because of this popular image, we tend to overlook the fact that Vermont has been a national leader in the production of iron, copper, slate, marble, and granite, and the manufacture of farm machines and machine tools; and that in the 19th century, most towns had at least one mill or factory and often more.

Typical of the mills were those engaged in the manufacture of iron, either working the ore into wrought iron at small bloomery forges, or smelting ore into cast iron in tall blast furnaces. These early forges dotted banks of swift-running streams and rivers, answering to the needs of the first Vermont settlers.

Associated with the making of iron was the need for charcoal to fuel the forges and furnaces. Initially made in mounds, charcoal kilns evolved into circular stone structures and eventually into round, red-bricked kilns. By the 1880s, hundreds of these kilns were reducing the Green Mountain forests into black charcoal for ironworks inside and outside Vermont.

Not directly associated with iron and charcoal making, yet somewhat related, was lime burning. Lime kilns also dotted the early countryside, capitalizing on both the agricultural and industrial need for burnt lime and the availability of limestone. Less well-known, and the least understood of rural furnaces, lime kiln ruins continue to mystify those who happen upon them in obscure corners of the forest, sometimes prompting speculation of prehistoric or exotic origins.

Hundreds of these ruins lie in varying degrees of abandon up and down the spine and the eastern and western slopes of the Green Mountains. Some tower dozens of feet upward; others display mere foundation walls. They range in shape from square to rectangular to oval. They are near waterways in broad valleys or high up in the mountains. Some are single ruins; some are clusters of ruins. Most are made of native Vermont stone. Some are made partially or wholly of brick. They are seemingly unconnected with the traditional concept of Vermont history.

Industrial Archeology

A new interest in the archeology of industrial history from social, technological, and architectural perspectives has gained momentum since the early 1970s. Studies of 19th-century factory systems and disciplines have revealed the social consequences of the period. Early-19th-century America saw the emergence of pioneer entrepreneur-owners of factories, mills, and forges. The post-Civil War period witnessed a dramatic consolidation of these entrepreneurships into a revolution of industry, as larger, more efficient factories demanded more raw materials, larger and faster machines, and more cheap labor. Finally came the revolution of industrial labor itself, as the working class found its identity and demanded its share of the fruits of the Industrial Revolution.

Archeologists sift through the remains of that period, identifying and interpreting the architectural, technological, and social dimensions of the artifactual remains. They do not see history as powdered wigs, pitched battles, and treaties. Rather, from the refuse discarded a century ago at today's site of workers' housing, the archeologist learns whether there was such a thing as a quality of life for the 19th-century factory family. Through meager historical records and field inspection, we can determine how technologically advanced (or backward) a forge may have been compared to its contemporaries nearby, in the next state, or in Europe. When we find, for instance, that an underpowered mill was operating in a remote corner of Vermont with machinery that was then already years behind the latest state of the art, what questions of economics must be considered? How could such an ancient and inefficient mill compete? Yet economics seems far removed from finding bits of slag, buttons, creamware, nails, and glass in a caved-in and overgrown cellar hole at a mountaintop mill site, abandoned 150 years ago, and apparently forgotten by everyone.

Those who search out and study these industrial remains are part of a relatively new discipline called Industrial Archeology (IA). The industrial archeologist seeks out, identifies, and records industrial sites. The industrial archeologist, working alongside architectural historians, is also concerned with the preservation of industrial structures. Abandoned mill and factory buildings have new life breathed into them through adaptive reuse, that is, renovating the structure (into, for example, shopping malls or condominiums) while retaining its basic architectural fabric.

Since the excavation and reconstruction of the Saugus Ironworks in the 1940s, a strong, continuing interest has developed in industries associated with making and working iron. A 1974 publication by the Council for Northeast Historical Archaeology included articles about work undertaken at the forges of Charlotteburg, New Jersey, and the iron industries in the vicinity of Seaford, Delaware (Lenik 1974:9-17; Heite 1974:18-34). The founding of the Society for Industrial Archeology (SIA) in 1971 gave archeologists and historians of industry a focal organization, reflecting the continuing growth of this interest in industrial archeology.

An immense amount of effort has been expended throughout the country to research, excavate, record, preserve, stabilize, and reconstruct the various remains of the iron industry. These efforts have, in most cases, afforded new insights into the technological state of the industry in the 18th and 19th centuries. Unfortunately, however, the number of papers that have been published on the results of these archeological projects falls far short of the quantity of work accomplished in the field. The following are some examples of what has been published, by the SIA, about the ironworks industry.

In 1981, Bruce Seely wrote a study of mid-19th-century blast-furnace technology using remains of the Adirondack Iron and Steel Company in northern New York State as the model. This

study was the product of a large recording project by the Historic American Engineering Record (HAER). Through inspection and interpretation of the remains of the blast furnace and machinery, Seely "fleshed out" the pattern by which this isolated charcoal iron furnace adapted its process rather than converting to coke for fuel, thereby demonstrating the complexity of technological innovation at the site. "The Adirondack Iron and Steel Company's history and site help to provide a more realistic picture of both the charcoal iron industry and the broader American iron industry as a whole by illustrating how some charcoal iron makers accommodated themselves to a period of changing technological possibilities in the late antebellum period" (Seely 1981:52).

Three years later Robert B. Gordon and Michael S. Raber conducted a study of an 1865 ironworks at Mine Hill, near Roxbury, Connecticut, in the west-central part of the state. The authors concluded that the physical and archival evidence illustrated the range of problems that such an enterprise faced in 19th-century America. Not all the obstacles were related to getting the machinery to work as it should; many times the best scientific opinions of the time were no match for the lack of practical experience needed to get the machinery to perform as expected in the first place.

> . . . the most eminent applied scientists in America, had little practical experience with iron and steelmaking—to which, at that time, science indeed had little to contribute. The notion that siderite was a "steel ore," originally suggested by Benjamin Silliman after his visit to Mine Hill in 1817, seems to have had a strong influence on successive owners of the property. . . . Large and in some cases apparently unnecessary expenditures were made by the proprietors . . . [who] . . . committed themselves to a series of iron and steelmaking procedures that were costly . . . the puddled steel process that they selected later was less labor-intensive but likewise required skills that were not easily found in the United States (Gordon and Raber 1984:33).

More recently, the SIA published a study by Nicholas Honerkamp of a pre-Civil War blast furnace that operated at Chattanooga, Tennessee. Honerkamp showed how a charcoal iron furnace that converted to coke was affected by "larger economic, political, technological, and ecological forces and conditions present in the South on the eve of the Civil War . . . research at sites such as Bluff Furnace compel archeologists to examine past cultural dynamics in order to explain adequately specific features of industrial sites. . . . Bluff Furnace, and other industrial sites like it, offer more than elegant reconstructions of past events. They challenge archeologists to carry out anthropology in the past tense" (Honerkamp 1987:55, 67).

In the area of charcoal making, the Society for Historical Archaeology (SHA) published a paper by Charles D. Zeier that dealt with archeological excavations conducted northeast of Eureka in central Nevada, and resulted in the identification and evaluation of a wide variety of charcoal-making sites. The charcoal-fueled smelters reduced silver ore in the 1870–1890 period. Although well past the time that most charcoal makers in Vermont and the Northeast had abandoned making charcoal in mounds in favor of structured kilns, mounds (called "ovens" in the paper) were still operating in Nevada up to the late 1880s.

These mounds were operated by Carbonari, that is, Italian charcoal burners, who emigrated to the west in the mid-19th century. Fuel for the mounds was pinyon and juniper wood, abundant in the vicinity. Production yield was in the range of 25 to 30 bushels of charcoal per cord of pinyon (compared with 30 to 35 bushels of charcoal per cord of wood generally realized by mounds in Vermont during an earlier period). The paper also addressed the chronology of charcoal production at Eureka, the ethnic affiliations of the charcoal burners, and the lifestyles of the Carbonari.

As in Vermont, historical accounts and technical literature provided scant information on charcoal making. "Evidence contained in historical documents provides only a limited picture of late nineteenth century charcoal production in the Eureka area. Much of the discussion is dominated by the ethnicity of the charcoal producers and their role in social and political events of the time. Limited information of a technical nature is presented. Earthen ovens were expected to be the predominant form of charcoal production, and few, if any, kilns were expected. Historical estimates of oven size and yield allowed the volume of archaeologically described pits to be estimated" (Zeier 1987:96-97).

Presentation of the Study

To simplify presentation of the furnace, forge, and kiln sites study, chapters 4, 6, and 8 are divided into northern, central, and southern districts, as follows:

District	Counties
Northern	Caledonia, Chittenden, Essex, Franklin, Grand Isle, Lamoille, Orleans, Washington
Central	Addison, Orange, Rutland, Windsor
Southern	Bennington, Windham

Physical disposition of the sites is indicated in maps accompanying each district presentation; photos and illustrations support the chapters.

All sites in the study are preceded by their site identification number, the principal (or assigned) site name, and town in which the site is located. Counties are presented in generally north-to-south order within districts; sites within counties in as close a north-to-south sequence as possible, regardless of their site number sequence. County abbreviations used in the site identification numbers are:

County	Abbr.	County	Abbr.	County	Abbr.
Addison	AD	Franklin	FR	Rutland	RU
Bennington	BE	Grand Isle	GI	Washington	WA
Caledonia	CA	Lamoille	LA	Windham	WD
Chittenden	CH	Orange	OR	Windsor	WN
Essex	ES	Orleans	OL		

The site identification numbers are a modification of those used by the Vermont Division for Historic Preservation for all recorded sites. Site number VT-BE-36, for example, assigned by the State Archeologist, identifies the site as being in Vermont (VT), in Bennington County (BE), and it is site number 36 (the 36th site recorded in that county). For the purposes of this work and since all sites are in Vermont, "VT-" is assumed and therefore deleted from the site identification number so that the site is identified as BE-36.

Sites formally reported to the state but considered inconclusive or of questionable archeological value are assigned field site (FS) numbers by the State Archeologist. AD-FS49, an example of a field site number used in this work, is the 49th field site recorded in Addison County. Note that FS49(AD) is the state's designation of this site. Identification of sites reported in this book but not yet formally reported to the state take a form dependent on whether the type of site is iron making, ironworking, or charcoal- or lime-burning related, as follows:

Type Site	Typical Ident. No.	Type Code
Blast Furnace	RU-IW03	IW = Ironworks
Bloomery Forge	AD-IW13	IW = Ironworks
Foundry	OL-IW03	IW = Ironworks
Charcoal Kiln	BE-CK02	CK = Charcoal Kiln
Lime Kiln	CH-LK01	LK = Lime Kiln

RU-IW03, for example, is the third unreported ironwork-related site in Rutland County; AD-IW13, although a bloomery forge, is likewise ironworks-related and also assigned the IW code. Unreported numbers repeat from "01" for each county; thus, it is not an error to have both AD-IW01 and RU-IW01. The county (AD versus RU) designation is the distinction.

All cities and towns mentioned are in Vermont unless identified by state. Repeated state identification is avoided in the sites chapters.

Results of the Study

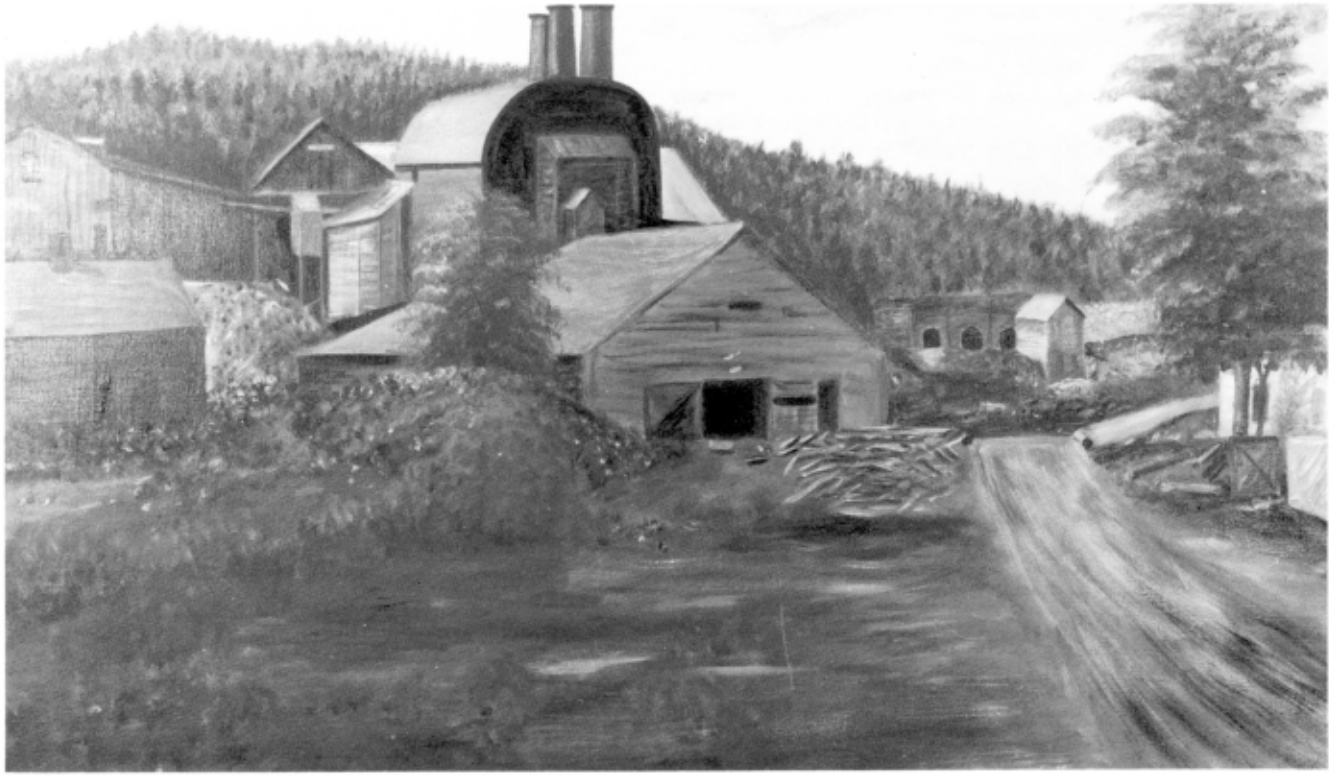
The number of industrial sites that have been identified, inspected, and recorded in Vermont as a result of this study bears witness to the technological impact that the Industrial Revolution made on the iron-making, ironworking, and charcoal- and lime-burning industries in the state. This is a fact that has not been fully reflected in most of Vermont's history books. Some books give the state's iron industry a scant sentence of recognition; others none at all. Most ignore altogether the charcoal- and lime-burning industries. Probably because they are still active, the state's granite, marble, and slate industries receive more attention.

This study, including all archival and field work, resulted in the identification of 288 sites of blast furnaces, bloomery forges, foundries, charcoal mounds and kilns, and lime kilns (see table below). Of these, 162 sites yielded 319 ruins or remains, which are now part of the State Archeological Inventory. Almost all ruins were found to be extremely fragile. Of the remaining 126 sites, 96 have not yet been precisely located (work-in-progress) and no surface remains were found at 30 others. Many of the latter are disturbed beyond surface recognition, but after further study might be determined to have some potential archeological value. Sadly, there will remain a significant number of sites that probably will never be found in the field, either due to insufficient archival data or because the sites have been completely destroyed through commercial development of the land or natural deterioration.

In terms of significant IA materials, the study found the ruins or remains of 22 blast furnaces, 18 bloomery forges, 5 foundries, 130 charcoal kilns, 51 charcoal mounds, and 93 lime kilns. The majority of these were built in the 1790s–1860s, which is the generally accepted period of the Industrial Revolution in the United States. These valuable artifacts are, therefore, some of the last physical links between the end of Vermont's pre-Industrial Revolution era and the modern industrial period.

Summary of Results

County	Ironworks		Charcoal		Lime Kilns		Total	
	Sites	Remains	Sites	Remains	Sites	Remains	Sites	Remains
Addison	32	17	13	26	12	10	57	53
Bennington	13	7	38	83	15	4	66	94
Caledonia	2		1		1		4	
Chittenden	7	2	1	2	5	5	13	9
Franklin	7	2			9	16	16	18
Grand Isle	1				1		2	
Lamoille	1		2		5		8	
Orange	1				1		2	
Orleans	2	1					2	1
Rutland	27	14	13	69	19	19	59	102
Washington	2		1				3	
Windham	1	1	1	1	16	12	18	14
Windsor	3	1	1		34	27	38	28
Total:	99	45	71	181	118	93	288	319



A ca.-1900 painting of Tyson Furnace by Myron Dimmick, who is supposed to have worked at the furnace. The blast furnace is in the center building with three chimneys; blast-producing machinery is in the building to the left (courtesy Vermont Historical Society).