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Machine Cut Nails and Wire Nails: American Production and Use for Dating 19th-Century and Early-20th-Century Sites

ABSTRACT

The commonly cited sources used by archaeologists for dating nails have been rendered outdated by later research. Machine cut and headed nails date from 1815 onwards, while wire nails date from 1819 onward. Historical archaeologists need to avoid the simplistic use of invention dates and patent dates and focus instead on the mass-production dates. There can be a significant amount of time between an invention and its first production, and even greater time until production figures are significantly high enough to affect the archaeological record. Usually wire nails are ascribed an 1850s beginning date, but that date is both too early and too late. While some wire nails were produced in 1819, no significant quantities were produced in the United States until the mid-1880s. Thus, we need to extend the manufacturing date back some 30 years with the caveat that the *effective* manufacturing date range begins in the 1880s. By examining production figures for wire nails, a model is generated for dating sites built of machine cut nails. This model is then examined using data from dozens of sites in the USA and Canada. Just as important, the model provides clues to recycling activity and access to different manufacturing sources.

Introduction

Nails are among the most commonly occurring artifacts found at 19th- and 20th-century sites, and, as such, nails are an important data source, often overlooked by some historical archaeologists. This article provides a model for dating 19th- and early-20th-century sites with nails and details how nails can be used to understand archaeological sites better. Documentary sources should take priority whenever possible, and other artifacts should be used as supportive evidence. Still, in many cases, it may be the nails that will provide a site's date, especially for undocumented, late-19th-century sites dotting the western landscape.

Unlike glass and ceramic sherds, nails in the ground become nasty rods of rust and dirt and just are not as pleasurable to study. However, like all artifacts, nails do bear a tale or two about the people who built with them and about the people who made, shipped, and sold them. Nails can yield at least five such tales: (1) size and style (e.g., roofing, finishing) often imply the specific use within a structure, (2) renovation of structures, (3) technology in manufacture, (4) technological and marketing lag in acquisition by user, and (5) chronology.

The first four of these may be approached via emic or etic routes, while the fifth is only etic; it is of interest only to the researcher trying to date a site. This article will explore aspects of chronology as used previously and suggest a new approach to dating archaeological sites using nails.

Archaeologists emphasize ceramics and glass to date sites, yet research has shown that because ceramic artifacts have such a long life span, their use as temporal indicators must include an analysis of time lag (Adams 2003). Research on late-19th-century sites indicates that ceramics date roughly 10–16 years earlier than the associated glass artifacts, which, in turn, date about 3–6 years older than the time of deposit (Riordan 1985:113–114; Adams 2003). Research on early-19th-century sites also indicates that time lag can be a significant factor earlier as well (Salwen and Bridges 1977). While the exact amount of time lag for durable goods will vary according to access to transportation networks, time period, wealth, and idiosyncrasy (to name just a few variables), time lag appears to be a significant and usually overlooked aspect in a site's history.

Documents provide the best evidence for the dates of site construction, but not all sites are blessed with detailed records. Without documents, the archaeologist must date the site using artifacts. The beginning date for a site may best be reflected in the building materials used to build the house or other building, items like nails, window glass, and wood dated by tree rings. Other artifacts found at a site may have been purchased at various times, but the construction materials should date closely to the construction date. Such commonplace artifacts are only useful if chronological differences exist.

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Karl Roenke (1978) proposed a model for dating window glass during the 19th century that holds considerable promise because he was able to demonstrate that window glass thickness increased during the 19th century. Later studies have shown the successes and pitfalls of using window glass to date sites (Rothman 1980; Moir 1987; Orser et al. 1987:528–548). Randall Moir 1987:78) has concluded that window glass can be used to date buildings built between 1810 and 1915.

Nails have generally been used to provide *terminus ante quem* and *terminus post quem* dates for sites. For example, the presence of modern machine-cut nails on a site means it must have been used or occupied in the 1830s or later. Another dating technique is seriation, in which artifacts are ordered based upon some attribute with chronological value. Since wrought nails preceded cut nails and both preceded wire nails, seriation should be a valid technique on 19th-century sites. At Waverly Plantation and at Bay Springs Mill in Mississippi, the sites were seriated on the basis of wrought versus machine cut or machine cut versus wire nails, and this order compared well with the order derived from oral, historical, and other artifact data (Adams 1980; Walker 1980:552–553; Adams et al. 1981; Rothman and Walker 1981:359–360). The Richland Creek sites in Texas were also seriated successfully using machine cut and wire nails. "The nail seriation graph provided a relative dating tool for the Richland Creek sites that closely paralleled other material culture, informant, and documentary placements" (Jurney 1987:90). While seriation may not be a precise dating method, its use is encouraged as a means of understanding site formation processes. For example, a site that seriates as being older but that can be documented as being considerably younger may, through seriation, suggest recycling of older building materials.

Albert Bartovics's (1981) dissertation cogently examined probability dating and influenced the present study considerably. His work showed that a similar approach could be used for nails, if only production figures could be obtained for different nail types. In the U.S. Census of Manufactures, some data were found for the change from cut to wire nails; these were graphed, along with the nail frequencies from the Waverly Plantation sites (Riordan and Adams 1980:591). That analysis indicated a very strong relationship could be established between the manufacturing data and the site's construction date. While this was believed to be a very promising predictive model, other research commitments precluded following up on it then. David Jurney did follow up the idea with the Richland Creek sites but found that the model produced dates "5 to 15 years too recent" (Jurney 1987:90). Over the ensuing years, the author collected data from a variety of sites to expand on the original study at Waverly.

Technology of Production

Until the late-18th century, blacksmiths working independently or at naileries wrought virtually all nails. These nails were wrought from nail rods or from nail splits cut from a plate. Smiths hammered the red-hot iron rods into a point and then placed them in a vise, hammering down to produce a head (Fontana and Greenleaf 1962:52). By virtue of being made individually by hand, wrought nails show considerable morphological and metric variability.

Jeremiah Wilkinson of Cumberland, Rhode Island, in 1775 devised a way of producing nails from iron plates (Fontana and Greenleaf 1962:44). The nails were hand headed and show variability in the heads but some uniformity in the shanks. Such nails "were made from rectangular strips of iron plate and tapered to a point by a single cut across the plate. The thickness and height of the plate determined the thickness and length of the nail" (Fontana and Greenleaf 1962:52). This kind of nail generally dates from ca. 1790 to the mid 1820s (Nelson 1968:6), although a few examples can date as early as the 1775 invention date. More research is needed to clarify the spread of this technology and ascertain production figures. Some of the rods for these nails were imported from England; for example, 2,307 pounds "in nail or spike rods, slit" were imported from England in 1824 (Secretary of the Treasury 1825:146–147).

Although the archaeological literature generally uses a date of ca. 1815 for the introduction of the early machine cut-and-headed nails following Lee H. Nelson (1968), later research has shown that the earliest such machines actually were in use was by 1794 near Boston: "North of the city, Jacob Perkins had nail-cutting and nail-heading machines in production in Byfield in 1794, and he helped establish a major factory along the Powow River in Amesbury in 1796" (Phillips 1994:6). These early nails were first made in a cutting machine and then taken to a separate machine for heading. In 1807, Jesse Reed invented a machine that could cut and head a nail, thus streamlining the process. The automation was refined in 1810 and 1814 (Phillips 1994:6). These early cut nails were made until the late 1830s and are distinguished by the tapering near the head and the irregular shape of the head (Nelson 1968:7). Also, the iron fibers run across the width, while later machine-cut nails had the fibers running lengthwise. These later machine-cut nails also had uniformly made heads and date from the late 1830s on to the present (Nelson 1968:7). However, one manufacturer, Perkins, claimed the grain ran lengthwise, as described in a 24 November 1795 newspaper advertisement from *The Impartial Herald* of Newburyport, Massachusetts: their "superiority to other cut nails consists in their being cut with the grain of the iron, whereas others are cut across the grain, consequently, these are much tougher, and in general, will clench equal to any wrought brads" (Phillips 1994:7). Although Perkins knew how to make nails with the grain, the quality of iron available to him may have curtailed his producing such nails, at least in quantity. No nails with lengthwise grain are known from samples in New England dating before 1835 (Phillips 1994:7).

Nelson (1968:8) distinguished five phases of machine-cut nail production: nails were cut from (1) common sides with hammered heads, 1790s–1820s; (2) opposite sides with hammered heads, 1810–1820s; (3) common sides with crude machine-made heads, 1815–1830s; (4) opposite sides with crude machine-made heads, 1820s–1830s; and (5) opposite sides with perfect machine-made heads, 1830s–present.

Based on samples from well-dated structures in New England, Maureen K. Phillips (1994:9) has derived three periods for machine cut nails (Table 1). More research is needed to establish if this regional chronology can be used elsewhere. Different regions adopted different technologies at different times.

The rise of wire nails depended upon the broader technology of wire production. Once wire was made in quantity, then wire nails could become a common spin-off industry. The invention of barbed wire in 1873 and the production of wire nails "probably accounted for the rapidity of the rise of wire" itself (Temin 1964:227). "Wire had been made before steel became a mass-produced article, but the quantities had been small" up to 1890 (Temin 1964:226). So, while the development of a wire industry had to precede the mass production of the wire nail; in the end, the wire nail—and barbed wire—stimulated further usages of wire. This is a classic feedback loop in technological development between such seemingly unrelated industries as the cattle industry, the building industry, and the telecommunications industry.

TABLE 1
THREE STAGES OF MACHINE CUT NAILS

Type	Early	Transitional	Modern
Date Range	post 1790 to ca. 1820	post 1810 to ca. 1840	ca. 1835 to ca. 1890
Shank Cross-Section	parallelogram (early) rectangular	rectangular	rectangular
Grain	cross-grain	cross-grain	longitudinal
Sides	2 tapered, 2 parallel	2 tapered, 2 parallel	2 tapered, 2 parallel
Burrs	diagonally opposite	same side edges	same side edges
Neck	pinched under head if machine headed	bevel under head less than 1/4	bevel under head is 1/3 or more
Head	(1) hand or (2) rose or T head or (3) machine headed	thicker, regular shape, concentric	convex on each side; uniform, thick
End	rounded	rounded	square/sheared

Source: Phillips (1994:9)

Although mass production would not happen until later in the 19th century, limited production actually began a half-century earlier than is commonly thought, based upon the usually cited literature. France issued patents for wire nails in 1806 (Fremont 1912:366–367). Wire nails were first produced in France in 1819, according to Charles Fremont (1912:366), much earlier than the early 1850s usually ascribed in the archaeological literature (Fontana and Greenleaf 1962; Nelson 1968:9–10). Here, again, is an example of the lag time between invention and production, in this case 13 years. The production date is the one of must use to archaeologists. One wire nail machine shown at the Paris Exhibition of 1844 and illustrated by Charles Laboulaye (1845:Figure 549) consisted "of a relatively sophisticated hand-cranked apparatus which cut, headed and pointed a nail from a coil of wire by a turn of the crank" (Priess 1973:88). Thus, one might expect that in French-settled portions of America, like Louisiana and Quebec, wire nails might be found in small quantities from 1819 onward. Similary, neighboring areas supplied by those French areas would also have earlier access. British patents for wire nails began in the 1850s (Priess and Shaugnessy 1972:17). The first production of wire nails in North America has had several claimants, and these range from 1851–1875 (Priess 1973:88; 1974). The first American patent appeared in 1877 (Priess and Shaugnessy 1972:54). In any case, wire nails in North America were not produced in significant quantities until the mid-1880s. The earliest American-made wire nails were not used in building construction, being limited to use in making small items like cigar boxes and for packing crates made from soft woods (Priess 1973:88). "American wire nail machinery was not really perfected until the 1860s and 70s" (Nelson 1968:10).

The machine cut nail was generally a superior nail for building purposes, depending upon the woods being used. Many farmers still prefer building barns with them, and they are the nail of choice for nailing wood to concrete.

> As the wire nail began to make inroads on the cut nail in the 1880's, manufacturers of cut nails took steps to regain as much of the lost trade as possible. ... They were able to demonstrate to their satisfaction that the cut nail was far superior. It had, they said, 75% to 100% greater holding power than the wire nail (Hogan 1971:190).

The federal government tested the new nails in 1884 (Anonymous 1886). Why then did a technologically inferior product supercede it?

> Wire nails were replacing cut nails for two reasons, their different shape and their different material. ... They were widely criticized for their lack of holding power, but this was offset by their greater ability to penetrate wood without splitting it. They also weighed less than cut nails of equivalent length, which meant a larger number of nails in a pound and consequent lower freight charges. For these reasons, the production of cut nails reached a peak in 1886 and fell thereafter, and the production of wire rods for wire nails rose (Temin 1964:227).

The reasons for the change, thus, were economic. Wire nails could be produced at less cost, and builders could buy them more cheaply. So when did the transition take place? In reality, there were two transitions occurring simultaneously: the switch in nail production from iron to steel machine-cut nails and the switch to wire nails.

> The nail manufacturing technique moved first from the iron cut nail to the steel cut nail and then to the steel wire nail. This change took place within the 20-year period from 1880 to 1900. At the beginning of this period, both the steel cut nail and the wire nail were not produced in commercial quantities since both were introduced in 1882 or 1883 (Hogan 1971:188).

The transition from iron to steel happened in the mid-1880s. "Steel was of increasing quality and cheapness; the price of steel nail plate probably fell below that of wrought-iron plate soon after the price of steel rails passed that of iron rails" (Temin 1964:227). The change to steel has been blamed on an 1885 iron puddler's strike in the Wheeling district, but this strike probably only slightly hastened the inevitable transition (Hogan 1971:189). If one can distinguish a steel nail in the assemblage, than it should postdate ca. 1882.

The introduction of the wire nail to the building trades had to overcome the conservatism often associated with crafts. The hardware stores had to be convinced, as well as the craftsmen. Based on information provided by James M. Swank (1892:450–451) of the American Wire Nail Company,

> Very great difficulty was experienced in inducing the hardware trade to recognize the wire brad and wire nail as a salable commodity. From 1878 to 1880,

> the growth of the wire nail was very slow and was attended with many difficulties. Deep-rooted prejudices of all kinds had to be overcome. It was not until the year 1883 or 1884 that the wire nail came into the market prominently as a competitor of the cut nail.

No figures exist for the 1882–1885 period of wire production, while the 1886–1890 figures are estimated because the naileries were so secretive (Hogan 1971:189). "The wire nail first appeared in considerable quantities in 1884" (Wright 1907:178). Thereafter, the market for wire nails rose rapidly. In 1884 one supply company (Thompson, DeHart and Company) in Portland, Oregon, listed only wire nails.

The following conclusions can be drawn regarding wire nails. Although patents were issued for wire nails as early as 1806, wire nails were probably not produced in any great quantity until 1819. Wire nails could be present on a site in very small numbers after 1819 as part of shipping boxes and furniture, especially if these originated in France or its territories. Larger sizes (for architectural construction) would not be present until the 1850s (and probably much later). From ca. 1851–1883, wire nails may begin to accumulate in sites in small numbers, but were probably not used in building structures simply because so few were produced. Structures built in the United States before 1883 were built entirely, or almost entirely, of machine cut nails or earlier types. On the other hand, structures built after about 1897 were most likely built using wire nails. Because the two major pioneering efforts usually cited (Fontana and Greenleaf 1962; Nelson 1968:9–10) provided the 1850s as the start of wire nail production and the 1890s as the major transition to wire nails, many archaeologists assume that a site with both kinds of nails dates from the 1851–1890s period, especially if the two kinds are about evenly frequent (Orser et al. 1987:558).

It must be understood is that just because patents exist for a technology or a technology is known to date from a certain point onward, it does not mean that those dates can be used for dating a site directly. In the case of wire nails, that 1850s date is both too late and too early. It is too late because small quantities could appear anytime after 1819. It is too early because most use of wire nails is much later. Based on the available manufacturing data, very few, if any, buildings in the United States could have been built using wire nails prior to about 1883. In the United States, virtually all construction of frame buildings after about 1900 used wire nails almost exclusively. Because British naileries switched to wire nails in the 1860s and 1870s, well ahead of the Americans, we would expect that British-supplied colonies, like Australia, New Zealand, and Canada, would have had earlier access to wire nails than the U.S. Import records in those places should establish the nail sources before trying to use wire nails for dating during this transitional period.

While those general statements are supported by the manufacturing data, we must always bear in mind that some carpenters were more conservative than others. One may well find a house constructed after 1900 using cut nails entirely or using them in special applications, but one will simply not find any houses built before 1883 using wire nails.

British vs. U.S. Production

While the transition from wrought nails to machine-made nails in the United States was in the 1820–1840 period, in Great Britain the transition came later, in the 1840–1860 period, apparently due to nail making trade unions' antimachinery policies (Ross 1980:1). Because of this, Lester H. Ross has suggested that "British sites in North America continued receiving wrought nails throughout the mid 1800s, possibly well into the late 1800s. Therefore British-supplied sites will have lower ratios of cut nails to wrought nails well into the century" (Ross 1980:1).

While the British initially lagged behind U.S. nail makers in adopting nail machinery, the result was that when they finally did adopt machines in any quantity during the 1860s and 1870s, those machines produced wire nails instead of cut nails. Thus, the U.S. nail makers (who adopted the wire nail in the mid 1880s) soon lagged behind the British. This is somewhat reflected in the number of nail machine patents granted (Table 2). The Americans were more inventive than the British in all the periods except during 1841–1860. But the greatest numbers for the British were in the 1861–1880 period, while for the Americans it was in the

TABLE 2
BRITISH AND AMERICAN PATENTS FOR ALL NAIL MACHINES

	American		British	
	N	%	N	%
Pre-1800	15	2.3	5	1.2
1801–1820	75	11.6	10	2.4
1821–1840	38	5.9	29	6.8
1841–1860	54	8.4	68	16.0
1861–1880	173	26.8	170	40.0
1881–1900	291	45.0	143	33.6
Total	646	100.0	425	100.0

Source: Priess and Shaugnessy (1972)

1881–1900 period. The jump in both cases was due to the increase in the numbers of machines for wire nails. A similar technological lag between British and American sites has been noted for window glass (Roenke 1978).

Canadian sites and American sites supplied with nails from Canada generally will have wrought nails in higher quantities and later in time. Peter Priess (1983) attributed this to two factors in particular: sites were developed by the British military or by the Hudson's Bay Company, and many of these sites were isolated. For example, in the British Columbia interior at Fort St. James, wrought nails were used in the late-19th century because this was less expensive than shipping cut or wire nails from Vancouver. Accordingly, older technologies continued to be used because of isolation, transportation costs, or conservatism.

Importation of Nails

In the 18th century and the first two decades of the 19th century, nails and spikes were imported in large quantities, reaching a peak of 4,122,942 pounds in 1802, with a steady decline after that point. This decline in imports largely resulted from American naileries meeting the domestic demand during the first decade of the 19th century but was accelerated by international events. The Embargo of 1807 and the Non-Intercourse Act of 1809 forbid commerce with the "belligerents" in Europe during the Napoleonic Wars. As a result, imported nails dropped from 3,072,238 pounds in 1807 to 156,253 in 1808. In 1810, 2,112,223 pounds of nails were imported, while 15,727,914 pounds (7,863.9 tons) of nails were produced in the United States, increasing to 207,882 tons by 1870. Thus by 1810, only 11.8% of the nails used in the country were imported (this ignores nail exports and re-exports). The War of 1812 also impacted nail importation. Perhaps stimulated by the need for domestic production, nail machines were improved during this time. By about 1815, nails were headed by machine and production soared.

The 1820 census did not provide a national summary. Each state varied its reporting standards, but one could possibly derive the figures if one were willing to check each county's figures. In 1820, New Hampshire produced 50 tons of nails (worth $8,500) on two nail machines and one cutting-and-heading machine and produced 35 tons of plates (worth $7,000) that included both nails and hoops. Maine had five nail machines, while Massachusetts had "18 nail machines, with the apparatus; 24 cutting machines." A Rhode Island slitting mill produced 1,500 pounds of nails per day.

Hand wrought nails were replaced by machine cut nails and, in turn, those were replaced by wire nails. The periods in which these replacements took place are generally accepted. Unfortunately, the archaeological literature is not clear on just how nebulous these dates really are in specific instances. Simply because a particular technology is known to have begun at a certain date does not mean that it was implemented immediately or that it was implemented in meaningful quantities. Wrought nails competed with machine cut nails successfully until the 1820s in the well-settled areas of the United States. Until the late 1830s, wrought nails were preferred for some purposes because they could be clinched (Nelson 1968:8–9). For the purposes of discussion here, based upon historical information, six periods are recognized: (1) antiquity–1790, wrought nails; (2) 1790–1820, early machine-cut nails; (3) 1820–1840, transitional machine-cut nails; (4) late 1830s–1882, machine-cut nails; (5) 1883–1897, transition to wire nails; and (6) 1897–present, wire nails.

When evaluating a site within this framework, the local and regional transportation system as well as local industries should be considered as well as regional and local variations in chronology. For example, pioneer settlers in the Midwest might well have had access to more advanced nail varieties coming down the Ohio River from Pittsburgh or upriver from New Orleans, while the more settled coastal South might have relied on the more archaic types being imported from England before the Civil War. While the study presented here relies on national production figures, archaeologists need to develop regional nail chronologies like that done for Louisiana (Edwards and Wells 1993) and New England (Phillips 1994).

Wire Nail Production Curve

In 1880, the U.S. production of wire nails was so insignificant that figures were not included in the Census of Manufactures; however, by 1886 the production of 600,000 kegs marked the beginning of the decline of machine cut nails (Table 3; Figure 1). By 1892, over half the nails made in the United States were wire nails. While the Wheeling strike may have accelerated this trend, clearly technological and market factors were also at work. The wire nail was easier to make and, therefore, less expensive to produce. Coupled with less expensive shipping due to its lighter weight, the wire nail outcompeted cut nails. By 1898, machine cut nails accounted for only 14.9% of U.S. production, falling to a low of 2.1% in 1919. The curve plotted for the decrease in proportion of cut nails is extremely steep from 1886 to 1898, when it begins a more gradual decline (Figure 1). The steep portion is interpreted here as being the result of a clearly superior technological advance coupled with the resultant market impetus derived from a less expensive product; whereas, the flatter curve is interpreted as resulting largely from demand with minor technological advances. The rise after 1923 is interpreted as being, in part, due to increased use of concrete construction, since machine cut nails are used in joining wood to concrete.

In 1897, 81% of all nails produced in the United States were wire nails. Those nails were shipped to stores and, therefore, approximately 81% of the replacement nails going into their bins were wire nails. All other factors being equal, this means that the average buyer during that year bought 81 wire nails per every 19 cut nails. Assuming the nails were used immediately, this means that the average house built in 1897 would have been constructed using 81% wire nails and 19% cut nails.

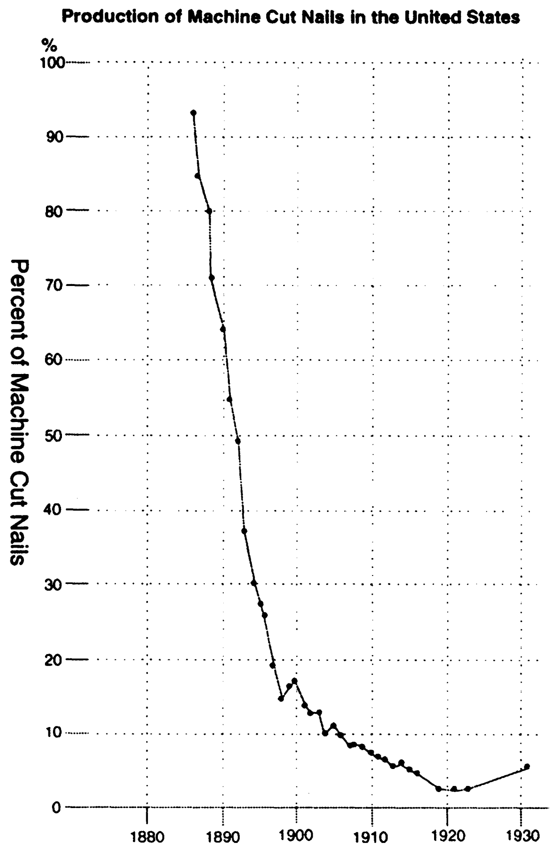

FIGURE 1. Percentage of machine cut nail production in the United States.

Of course, such a house, which so nicely fit the production statistics, never existed. Other factors affect the process. First, the nails would take some time actually getting from manufacturer to wholesaler to retailer to customer to board. How much time should it take? Timothy Riordan (1985) has determined that bottles at Fort Walla Walla took about 4.5 years on average to go from manufacturer to disposal. Nails have a lot longer shelf life. Second, this statistic should only work if all the nails were mixed randomly in a barrel by size, and the person did not take the time to pick out what was really wanted, an unlikely scenario. Third, the statistic ignores the likelihood that some carpenters would prefer one kind of nail to another.

A host of other assumptions can be assembled. The U.S. Census figures for production for wire

TABLE 3
AMERICAN NAIL PRODUCTION, 1886–1954 *

Year	Cut Nails**	Wire Nails**	Total	% Cut	% Wire
1880	5,056,600	∞	5,056,600	-	-
1886	8,160,973	600,000	8,760,973	93.2	6.8
1887	6,908,870	1,250,000	8,158,870	84.7	15.3
1888	6,493,591	1,500,000	7,993,591	81.2	18.8
1889	5,810,758	2,435,000	8,245,758	70.5	29.5
1890	5,640,946	3,134,911	8,776,857	64.3	35.7
1891	5,002,176	4,114,385	9,117,011	54.9	45.1
1892	4,507,819	4,719,524	9,227,343	48.8	51.2
1893	3,048,933	5,095,945	8,144,878	37.4	62.6
1894	2,425,060	5,681,801	8,206,861	30.4	69.6
1895	2,129,894	5,841,403	7,971,297	26.7	73.3
1896	1,612,870	4,719,860	6,332,730	25.4	74.6
1897	2,106,799	8,997,245	11,104,044	19.0	81.0
1898	1,572,221	7,418,475	10,562,917	14.9	85.1
1899	1,904,340	7,599,522	11,408,202	16.7	83.4
1900	1,573,000	7,234,000	8,807,000	17.1	82.9
1901	1,542,240	9,803,822	11,346,062	13.6	86.4
1902	1,633,762	10,982,246	12,616,008	12.9	87.1
1903	1,435,893	9,631,661	11,067,554	13.0	87.0
1904	1,283,362	11,926,661	13,210,023	9.7	90.3
1905	1,357,549	10,854,892	12,212,441	11.1	88.9
1906	1,189,239	11,486,647	12,675,886	9.4	90.6
1907	1,109,138	11,731,044	12,840,182	8.6	91.4
1908	956,182	10,662,072	11,619,154	8.2	91.8
1909	1,207,507	13,016,053	15,123,650	8.0	92.0
1910	1,005,233	12,704,902	13,710,135	7.3	92.7
1911	967,636	13,437,778	14,405,414	6.7	93.3
1912	978,415	14,659,700	15,638,115	6.2	93.8
1913	842,038	13,559,727	14,401,765	5.8	94.2
1914	769,665	13,132,814	13,002,470	5.9	94.1
1915	775,327	14,583,026	15,358,353	5.0	95.0
1916	764,835	17,147,665	17,912,500	4.3	95.7
1919	263,896	12,429,195	12,693,091	2.1	97.9
1921	318,008	11,297,861	11,615,869	2.7	97.3
1923	460,061	17,375,606	17,835,667	2.6	97.4
1927	-	14,819,159	-	-	-
1929	-	13,600,673	-	-	-
1931	457,962	8,177,139	8,635,101	5.3	94.7
1947	567,260	16,154,020	16,721,280	3.3	96.7
1954	1,569,000	11,870,020	13,439,020	11.7	88.3

* Raw data for 1886–1900 are from Hogan (1971:190); raw data for 1901–1916 are from American Metal Market (1918:103); 1919–1923 data from U.S. Census of Manufactures (1923:393); 1927–1931 data from U.S. Census of Manufactures (1931:836–837, 868–869).

** Figures given are numbers of 100 pound kegs.

∞ No wire nails were reported in 1880 (U.S. Census of Manufactures 1900:Table 52).

and cut nails are presumably accurate. General stores and hardware stores would have stocked nails in proportion to their respective production quantities. All distributors of nails are guided by market economy; that is, they will sell at best price. The buyer will select nails on the basis of price. Nails used for construction of a building represent the percentage made in that year. Nails are not only reused, they are used for purposes other than fastening wood (e.g., to hang clothing on walls). A building is repaired with nails bought at a later time, so the longer a building is in use, the higher the number of more recent nails and other fixtures in it.

The archaeological assemblage recovered is a representative sample of the range of nails used in a site.

With all of these assumptions and problems in mind, several sites' date ranges can be plotted against their percentages of wire and cut nails. Four tenant farmer sites at Waverly Plantation in Mississippi (Figure 2; Tables 4 and 5) were examined. Three sites began for certain about 1890, the other about 1909, based upon oral data and supported by artifacts (Riordan and Adams 1980). Plotting their date ranges at the point on the vertical axis representing the percentage of machine cut nails, it is noted how close each initial date is to the manufacturing curve for cut and wire nails. The sites fall within about two years on either side of the curve. Using the curve, dates of 1888, 1891 (2), and 1906 are indicated. This is remarkably close, but is it real? Henry Goodall was married in 1883, and by the 1890s he lived in the cabin at site 22CL571B. Thus, that site may date from 1883 onward. The other two earlier sites may date from the mid-1880s also. So the general trend based upon these sites only is that the manufacturing production curve date will be roughly two to five years later than the site's construction date. A sample size of four sites is statistically meaningless, but suggestive nevertheless.

Next, the nail probability curve was plotted for the sites at Silcott, Washington (Adams et al. 1975; Adams 1977). The house at the Ireland Place was built in 1884. A nearby outbuilding was built then or later; the curve indicates a date of 1894 given that 30% were machine cut nails (Figure 3; Tables 4 and 5). Bill Wilson's store was built in 1910. With only 5.2% cut nails in the assemblage, this figure would date the store to 1915 on the curve. Trapper Wilson's house was built about 1900; its 3.3% cut nails produced a projected date of about 1917. The Ferry Tender site was built about 1910 also, completely using wire nails, so a date after 1923 or later would have been suggested. Thus, the probability curve dates for these four sites were 10, 5, 17, and 13 years later than the known construction date, with a mean difference of 11 years.

This example clearly indicates that simply looking up the percentage of nails used (Table 3) will not establish the construction date. The

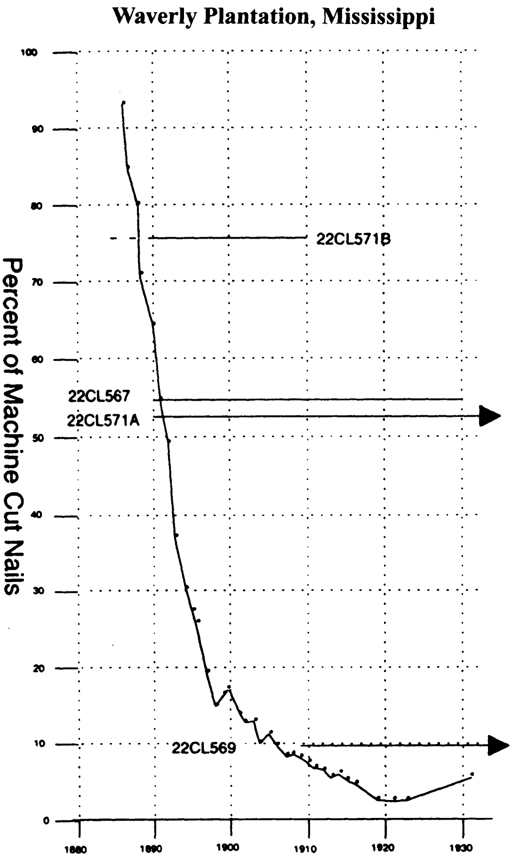

FIGURE 2. Percentage of machine cut nails at tenant farmer houses, Waverly Plantation.

model, while useful, needs further testing to explain why such differences have been found. At Silcott, the structures were modest one- and two-story houses with parlor, bedrooms, and kitchen. Yet these were more substantial and larger than the ones at Waverly, which were one-room and two-room cabins. The socioeconomic level separating the tenants at Waverly from the landowners at Silcott was considerable, although neither was wealthy by any means. The Silcott buildings were larger, and their occupants could afford repairs easier. Did this result in the higher numbers of wire nails? Did the tenants recycle materials from older buildings?

The next group of sites examined are those from Richland Creek, Texas (Jurney 1987). Plotting the frequency of machine cut and wire nails from those sites using the manufacturing curve shows rather conclusively that the model

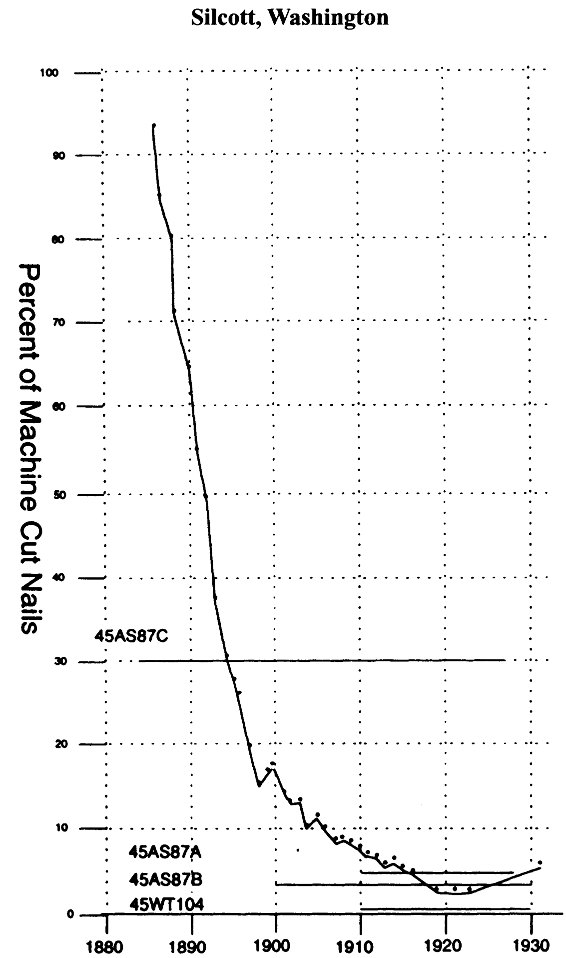

FIGURE 3. Percentage of machine cut nails at Silcott, Washington.

cannot be used to date the site without some mathematical adjustment (Figure 4; Tables 4 and 5). The model still does have chronological significance, in that it shows two trends. First, the longer a structure existed past 1890, the higher the frequency of wire nails used in it; this reflects the likelihood that repairs would be made with the most available nails. The second trend is that the later in time a structure is built, the higher the frequency of wire nails. Both these trends would be expected from the known historical data.

Structures built in the 1870s in the Richland Creek area, for the most part, show frequencies of machine cut nails greater than 50%. The one exception to this was site 41NV101, dating 1877–1940. None of these sites was built in the 1880s, so we cannot generalize about that period. All sites built in the 1890s (except 41FT143) were built almost entirely of wire nails. The model does suggest a way of examining sites further. For example, at site 41NV254W, the presence of 15.4% wire nails suggests that the building was repaired later than the 1880 terminal date given for the site. At site 41FT143, the high numbers of machine cut nails indicate that the structure might have been built of recycled materials, built by a more conservative builder, or possibly built as an outbuilding.

Next, various structures associated with Millwood Plantation in South Carolina and Georgia (Orser et al. 1987) were examined. Nine sites with large sample sizes were selected (Figure 5). The percentage of machine cut nails in the assemblage was recalculated by ignoring the unidentified nails. Two sites, 38AB12 and Site 17, fit the model almost exactly with their initial dates being three years later and one year earlier respectively. The other sites, with one exception, show that even when constructed in the 1860s or 1870s using machine cut nails, the wire nails ended up being a significant part of the assemblage. Site 9EB253 cannot have been dated correctly in the original study, since no site built and occupied only in the 1860s should have any wire nails in it. Clearly, the site dates to the 1880s or had extensive repairs made to it later.

Based upon the wire nail frequency at the late-19th and early-20th century sites examined here, the manufacturing curve cannot be used to determine an accurate construction date directly. The initial dates for most sites are usually 15–20 years earlier than that suggested by the manufacturing curve. Part of the difference may be a result of using artifacts to date most of these sites. Studies from Silcott and Fort Walla Walla indicate that the manufacturing dates for glass and ceramics are much earlier than the time these were discarded in a site, roughly 5 years for glass and 10 to 16 years for ceramics (Riordan 1985; Adams 2001). This finding would help explain why the Silcott and Waverly Plantation sites fit the curve much closer than the other sites examined here. Without examining the other collections, one cannot know how much time lag was a factor in the dates provided for the site.

TABLE 4
NAIL FREQUENCY (SORTED BY WROUGHT, THEN MACHINE CUT)

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Indet.	Total	Source
			N	N	N	N	N	N	
Coteau du Lac	9G	1779–1872	23,113	-	2645	366	69	26,193	Priess 1972
Fort Okanogan	-	1811–1831	483	75	-	-	-	558	Grabert 1968
Fort Vancouver: OAS Sale Shop	-	ca. 1829–1860	3973	-	1971	15	17	5,976	Hoffman & Ross 1974a
Fort Vancouver: Sales Shop	-	ca. 1829–1860	3466	-	2040	-	27	6,961	Hoffman & Ross 1974a
Fort Vancouver: Chief Factor's House	-	ca. 1837–1860	488	-	335	-	21	844	Hoffman & Ross 1973
Fort Vancouver: Indian Trade Store	-	ca. 1834–1860	2547	-	1497	326	1125	5,495	Hoffman & Ross 1975
Fort Vancouver: Blacksmith Shop	-	ca. 1834–1860	919	-	940	1	33	1,893	
Rocky Mountain House	-	1799–1834	38	41	-	-	10	89	Noble 1973
Fort Vancouver: Fur Store	-	ca. 1829–1860	2696	-	5292	-	11	7,999	Hoffman & Ross 1974b
Sinclair	-	1790–1810	97	289	-	-	1105	1491	Moore 1983
Sitka Hospital, Feature 12	-	ca. 1860	106	17	219	10	38	390	Musitelli 1986
Willamette Mission	-	1834–1841	185	-	659	-	893	1,737	Sanders et al. 1983
Jones	-	1800–1860	137	-	1059	-	3153	4349	Moore 1981
Fort Atkinson	-	1820–1827	92	-	2005	-	459	2,556	Carlson 1979
Champoeg	Block 53	1830–1861	1	-	33	-	-	34	Speulda 1988
Champoeg	Block 12	1830–1861	3	-	303	-	1	30	Speulda 1988
Champoeg	Montcalm St.	1830–1861	4	-	408	-	-	412	Speulda 1988
Champoeg	Block 1	1830–1861	7	-	984	2	1	994	Speulda 1988
Pikes Bluff	-	1830–1857	2	-	219	-	775	996	Moore 1983
Arkansas Bank	-	1840–1863	-	-	1217	-	-	1,217	Walker 1971
Bay Springs Millworkers' Barracks	22TS1108	1852–1885	-	-	249	-	26	275	Adams et al. 1981
Bay Springs Union Factory	22TS1103D	1852–1885	-	2	9669	-	275	9,946	Adams et al. 1981
Bay Springs Millworkers' House	22TS1115	1852–1885	-	-	248	-	5	253	Adams et al. 1981
Bay Springs Millworkers' House	22TS1103C	1852–1885	-	-	20	-	-	20	Adams et al. 1981
Richland Creek	41NV254E	1870–1880	-	-	79	-	-	79	Jurney 1987
Richland Creek	41NV306	1875–1905	-	-	22	-	-	22	Jurney 1987
Harmony Borax Works:	CL	1883–1888	-	-	263	-	-	263	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T4A	1883–1888	-	-	8	-	-	8	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T4B	1883–1888	-	-	95	-	-	95	Teague & Shenk 1977
San Juan: English Camp, Commissary	45SJ24	1859–1970	-	-	739	-	825	1,564	Sprague 1983
San Juan: English Camp, Older Barracks	45SJ24	1859–1970	-	-	884	-	1152	992	Sprague 1983
San Juan: English Camp, Captain's House	45SJ24	1859–1900	-	-	2453	-	1045	3,498	Sprague 1983
San Juan: San Juan Town	45SJ290 Op.1	1859–1872	-	-	7424	4	-	7,828	Sprague 1983
San Juan: American Camp, Officers' Row	45SJ300	1859–1872	-	-	868	2	-	870	Sprague 1983

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Indet.	Total	Source
San Juan: American Camp, Officer's Quarter	45SJ300 Op.4	1859–1872	-	-	1721	8	-	1,729	Sprague 1983
Bay Springs Mill Outbuilding	22TS1103B	1852–1885	-	-	408	3	17	428	Adams et al. 1981
Bay Springs Millworkers' House	22TS1103A	1852–1885	-	1	2803	45	11	2,859	Adams et al. 1981
Harmony Borax Works:	P	1883–1888	–	-	495	15	-	510	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T2	1883–1888	-	-	31	1	-	32	Teague & Shenk 1977
Millwood Plantation	Site 1	ca. 1860–1900+	-	-	5420	214	1224	6858	Orser et al. 1987
Millwood Plantation	Site 2	ca. 1860–1900+	2	-	763	30	42	837	Orser et al. 1987
Millwood Plantation	Site 7	ca. 1860–1890+	-	-	877	36	-	913	Orser et al. 1987
Bay Springs Millworkers' Barracks	22TS1109	1852–1885	-	-	1003	44	3	1,050	Adams et al. 1981
Fort Colville: Angus MacDonald	-	1871–1907	-	-	22,000	1000	-	23,000	Saastamo 1971
San Juan: English Camp, Newer Barracks	45SJ24	1859–??	-	-	382	28	726	1,136	Sprague 1983
Richland Creek	41NV254W	1870–1880	-	-	179	13	-	192	Jurney 1987
Millwood Plantation	Site 8	ca. 1870–1930	1	-	559	49	26	635	Orser et al. 1987
Kiowa/Comanche Indian Agency	-	1869–ca.1881	-	-	10,071	824	-	10,895	Crouch 1978
Waverly: Mill and Cotton Gin	22CL575	1842–1907	-	-	142	15	-	157	Adams 1980
Richland Creek	41NV145	1859–1915	-	-	352	72	-	424	Jurney 1987
Fort Bowie	-	1868–1894	59	-	334	18	-	411	Herskovitz 1978
Millwood Plantation	Site 23	ca. 1860–1910	2	-	650	156	80	888	Orser et al. 1987
Bay Springs Millworkers' House	22TS1111	1852–1885	-	-	22	6	-	28	Adams et al. 1981
Bay Springs Commissary	22TS1113	1852–1885	-	-	70	19	55	144	Adams et al. 1981
Reward Mine	Site 19	-	-	-	18	6	-	24	Teague 1980
Waverly: Henry Goodall's House	22CL571B	ca. 1890–1910	-	-	1908	614	-	2522	Adams 1980
Spalding: Sutler's Store	A	1869–1880	-	-	613	229	6	848	Chance & Chance 1985
Richland Creek	41NV235	1855–1905	-	-	-	-	-	-	Jurney 1987
Millwood Plantation	Site 6	ca. 1860–1890+	1	-	1155	570	116	1842	Orser et al. 1987
Spalding: frame building	B	1866–1879	-	-	434	229	-	663	Chance & Chance 1985
Spalding: Major Truax's Stable	C	ca. 1869–ca. 1879	-	-	1674	881	14	2569	Chance & Chance 1985
Spalding: large white building	D	ca. 1880–1902+	-	-	660	372	-	1032	Chance & Chance 1985
Richland Creek	41NV102 old	1873–1945	-	-	400	256	-	656	Jurney 1987
Bay Springs Store	22TS1105	ca. 1852–1979	-	-	214	170	178	562	Adams et al. 1981
Millwood Plantation	Site 17	1890–1900+	7	-	1944	1506	236	3693	Orser et al. 1987
Waverly: Belle Scott Site	22CL567	ca. 1890–1930	-	-	675	580	-	1235	Adams 1980
Richland Creek	41NV267	1873–1910	-	-	150	128	-	278	Jurney 1987
Waverly: Ellen Mathews's House	22CL571A	ca. 1890–1942	-	-	3766	3400	-	7166	Adams 1980
Bay Springs: Tobe Eaton	22TS1504	ca. 1894–1980+	-	-	225	246	-	471	Smith et al. 1982
Richland Creek	41FT143	1895–1953	-	-	50	56	-	106	Jurney 1987
Skagway: William Moore Cabin	-	1888–1900	-	-	54	77	4	135	Blee 1988
Richland Creek	41NV102 new	1873–1945	-	-	38	62	-	100	Jurney 1987
Millwood Plantation	9EB253	1860–1870	-	-	296	504	130	930	Orser et al. 1987
Richland Creek	41NV101	1877–1940	-	-	57	128	-	185	Jurney 1987
Bay Springs: James T. Butler	22TS995	ca. 1870–1980+	-	-	42	97	-	139	Smith et al. 1982
Silcott: Ireland Place	45AS87C	1884–1927	-	-	368	1375	-	1743	Adams 1977

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Indet.	Total	Source
Harmony Borax Works: Adobe B	T3	1883–1888	-	-	26	86	-	112	Teague & Shenk 1977
Reward Mine	-	-	-	-	88	333	-	421	Teague 1980
Millwood Plantation	38AB12	1900–1930	-	-	255	1028	11	1294	Orser et al. 1987
Bay Springs: Nancy Belle Holly	22TS1502	1904–1980+	-	-	56	318	-	374	Smith et al. 1982
Skagway: Bernard Moore House	-	1900–1914	-	-	25	156	10	191	Blee 1988
Waverly: Aaron Mathews's	22CL569	ca. 1909–1970	-	-	561	5216	-	5777	Adams 1980
Silcott: Bill Wilson's Store	45AS87A	1910–1928	-	-	171	3087	-	3257	Adams 1977
Richland Creek	41NV253	1910–1940	-	-	-	-	-	-	Jurney 1987
Silcott: Trapper Wilson's House	45AS87B	1900–1930	-	-	29	858	-	887	Adams 1977
Reward Mine	Site 44	-	-	-	6	190	-	196	Teague 1980
Bay Springs: John Eaton	22TS1505	ca. 1894–1952	-	-	1	34	-	35	Smith et al. 1982
Bay Springs: Ezra Searcy	22TS568	ca. 1900–1980	-	-	2	75	-	77	Smith et al. 1982
Richland Creek	41NV251	1890–1955	-	-	-	-	-	-	Jurney 1987
Skagway: Peniel Mission	(gold rush)	1897–1900	-	-	26	1795	-	1821	Rhodes 1987
Bay Springs: Tipton/O'Neal	22TS1506	ca. 1909–1980+	-	-	2	70	-	72	Smith et al. 1982
Richland Creek	41NV147	1910–1940	-	-	-	-	-	-	Jurney 1987
Bay Springs: R.G. Adams	22TS1507	1913–1980+	-	-	3	343	-	346	Smith et al. 1982
Richland Creek	41NV316	1900–1950	-	-	-	-	-	-	Jurney 1987
Richland Creek	41NV285	1895–1955	-	-	-	-	-	-	Jurney 1987
Richland Creek	41NV289	1898–1965	-	-	-	-	-	-	Jurney 1987
Silcott: Ferry Tender Site	45WT104	1910–1930	-	-	3	2641	-	2,644	Adams 1977
Bay Springs: Billie Eaton	22TS1503	ca. 1905–1980+	-	-	-	52	-	52	Smith et al. 1982
Richland Creek	41NV258	1915–1960	-	-	-	-	-	-	Jurney 1987

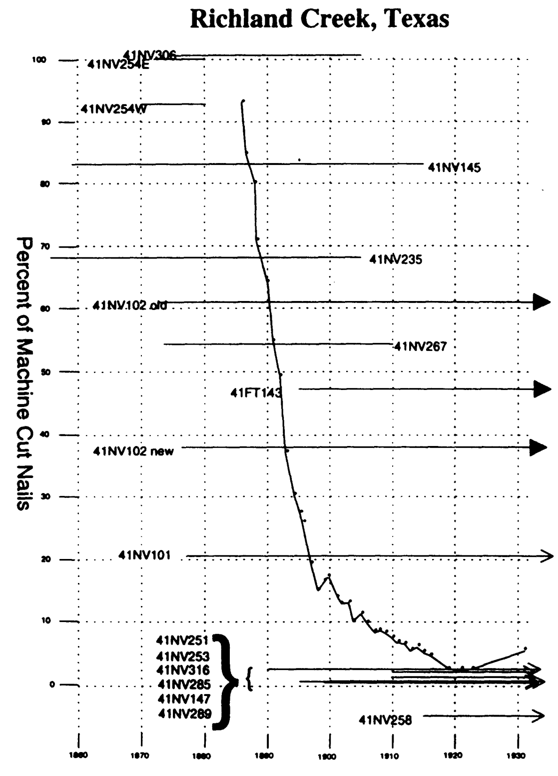

FIGURE 4. Percentage of machine cut nails at sites Near Richland Creek, Texas.

Another factor with the Richland Creek sites is that the samples were largely excavated in the yards using 50-cm units. While such a method is effective for spatial distribution analysis, its use for material culture study of the site remains unproven.

Obviously, the model presented here would be much improved by using short-term occupations from sites historically well documented, like the Harmony Borax Works (Teague and Shenk 1977). Unfortunately, finding site reports meeting those criteria is extremely difficult. Artifact dates are, at best, only probability statements due to the many variables inherent in each. Far too many archaeologists believe that that the number produced by the Mean Ceramic Date formula is really a calendarial date. It is not. The result is a number that needs interpretation, factoring in cultural factors such as time lag, economic status, social status, historical geography, and so forth.

While the production curve, in theory, might provide a relatively accurate dating method for late-19th and early-20th-century site construction, its application appears limited. Perhaps if more researchers would conduct similar analyses, more could be learned about the relationships between production curves and the use of nails in buildings. The production curve provides, at the very least, a graphic means of visualizing the site construction and repairs. In addition, it provides with clues as to earlier adaptation of new technologies for nail production.

Hypothetical Machine-Cut Nail Production

Excellent production figures are available for the transition from machine cut nails to wire nails in the United States. If similar production figures were available for the rise of machine cut nails, this model could address most of the 19th century. The production curve can be approximated by using an adjusted mirror image of the decline of the machine cut nail to describe the decline of the wrought nail to produce a graph portraying the relative frequency of production for nails during the 19th and 20th centuries (Figure 6). In 1790, the production of machine made nails began in the United States. Using the mirror image of the manufacturing machine-cut nail curve, we can project that by

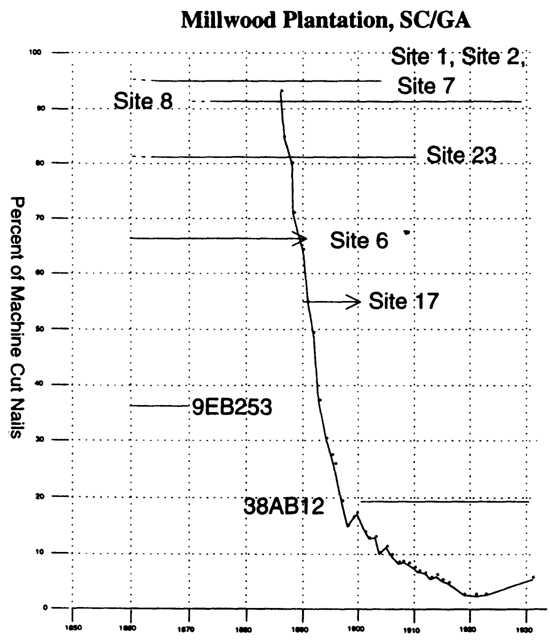

FIGURE 5. Percentage of machine cut nails at sites at Millwood Plantation.

1810 roughly 70% of the nails made in the United States might have been made on a nail machine and by 1820, 95%.

Wrought nails continued to be made until late in the 19th century, however, in small quantities and particularly in remote areas. An insignificant quantity continues to be made up to the present time.

Beginning in about 1807, machine cut and machine-headed nails began to be produced. By about 1830, using this model, 70% of the nails made would have been machine headed and by 1850, about 95%. Until 1883, machine nails continued to be about 95% of the nails produced.

At archaeological sites of early- to mid-19th-century, in fact, the frequency of machine cut and headed nails in many instances is remarkably close to the projected curve (Figure 7). Unfortunately, most of the sites shown here before 1840 are in the Pacific Northwest and were at the time of their use far from centers of nail production. Fort Vancouver imported American made, machine cut nails by the late 1840s (Ross 1976:891). Machine cut nails at the Fort Vancouver sites (ca. 1829–1860) ranged from 33% to 66.2% (Tables 4 and 5), with the rest being primarily wrought nails (Hoffman and Ross 1973, 1974a, 1974b, 1975; Ross et al. 1975; Steele et al. 1975; Ross 1976). The 1850 quartermaster's requisition for the Division of the Pacific sought 600 kegs of cut nails and 75 kegs of wrought nails, plus 5,000 pounds of wrought spikes and 50 kegs of cut spikes (Vinton 1976); thus, 88.9% of the nails to be used that coming year were cut nails. Fort Okanogan (1811–1831) had only 13.4% machine cut nails (Grabert 1968). Two plantation sites in coastal Georgia (Sinclair and Jones, begun in 1790 and 1800 respectively) had 66.2% and 88.6% machine cut nails (Tables 4 and 5) (Moore 1983) and, thereby, suggesting that sites with good access to commodity flows may show higher percentages of machine made nails at an early date.

Sites constructed from 1830 to 1860 generally were built using machine cut nails: Arkansas Bank (1840–1863), 100% machine cut (Walker 1971); Champoeg (1830–1861), 97–99.1% (Speulda 1988:86–87); and the Bay Springs Union

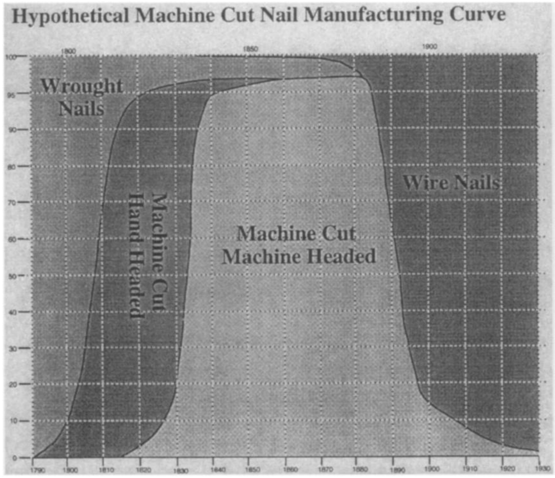

FIGURE 6. Hypothetical manufacturing curve for machine cut nails.

Factory and associated buildings (1852–1885), seven sites 95.7–100% and two sites 78.6% (Adams et al. 1981).

Structures built in the late 1860s and 1870s yield from 100% to 30.2% machine cut nails (Tables 4 and 5); however, this lower range reflects the long-term occupation of most sites analyzed. Long usage would have necessitated repairs with wire nails. Two of the Richland Creek sites built in the 1870s had a short-term occupation and show very high frequencies of machine cut nails: 41NV254E, 1870–1880, 100%; 41NV306, 1875–1905, 100% (Jurney 1988). At Fort Colville, the Angus MacDonald house (1871–1907) contained 95.6% machine cut nails (Saastamo 1971). The Kiowa/Comanche Indian Agency, dating 1869–ca. 1881, was built with 91.5% machine cut nails (Crouch 1978). Fort Bowie, 1868–1894, was built primarily of machine cut nails, 81.3%, and wrought nails, 14.3% (Herskovitz 1978). Three buildings at Spalding Indian Agency in Idaho, built in 1866 and 1869 and lasting until 1879 or 1880, produced a range of 72.8% and 65.5% machine cut nails (Tables 4 and 5) (Chance and Chance 1985). The relatively high numbers of wire nails in buildings with terminal dates of 1880 is unlikely based upon the data presented here. While some wire nails could have been used in packing crates sent there and then recycled, the frequency seems much too high for that

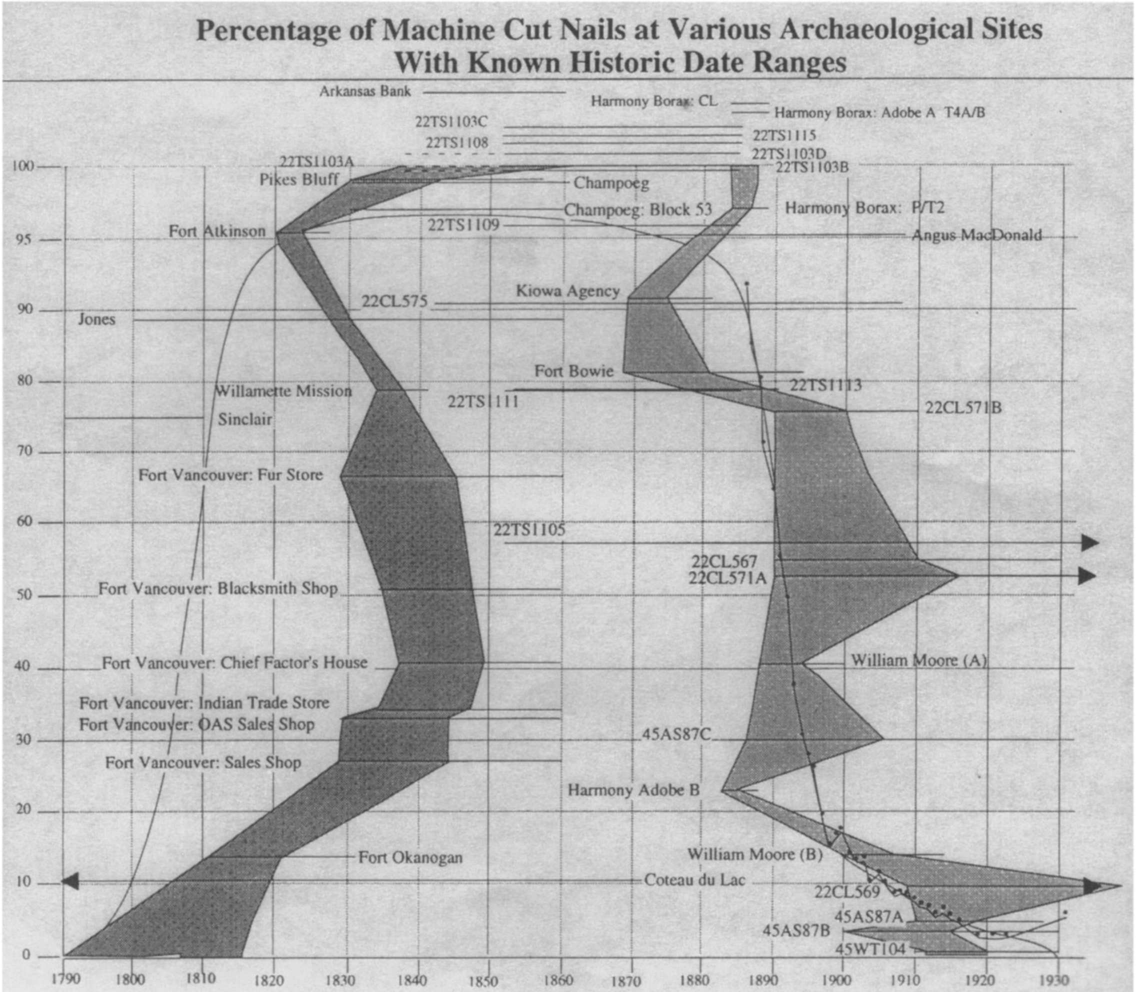

FIGURE 7. Percentage of machine cut nails at 19th-century sites.

explanation. It could be concluded that the structures lasted much later than reported, probably into the 1890s.

Relatively few sites constructed in the 1880s were analyzed. As would be expected from the production curve (which ranges from 95% to 70.5% machine cut nails during the 1880s), a considerable variation exists. At Harmony Borax Works, 1883–1888, Adobe A samples ranged from 96.9% to 100%, whereas Adobe B was 23.2% (Teague and Shenk 1977). This difference suggests that Adobe B was built somewhat later than Adobe A. At the Bernard Moore house in Skagway, 41.2% of the identified nails in the 1888–1900 context were machine cut; these mainly were found in a drainage ditch dug around the house in 1888 and may be related to the roofing done at that time (Blee 1988:53, 155). The higher number of machine cut nails there may reflect use in roofing, based upon a resurgence of cut nails for that purpose (Fontana and Greenleaf 1962). At Silcott, the Ireland Place was built in 1884 and torn down in 1927; it had 23.2% machine cut nails (Adams et al. 1975).

Sites with beginning dates from the 1890s yield 75.6% to 0.1% machine cut nails (Tables 5 and 6), while sites with beginning dates in the 1900s yield 15.0% to 0.0% machine cut nails. Because machine cut nails are still produced for special purposes like joining wood to concrete, structures built in the 20th century may contain a limited number of them. The excavations at the Depot Building in Skagway revealed a

TABLE 5
NAIL FREQUENCY PERCENTAGES (SORTED BY WROUGHT, THEN MACHINE CUT)

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Total	Source
			%	%	%	%	%	
Coteau du Lac	9G	1779–1872	88.5	-	10.1	1.4	100.0	Priess 1972
Fort Okanogan	-	1811–1831	86.6	13.4	-	-	100.0	Grabert 1968
Fort Vancouver: OAS Sale Shop	-	ca. 1829–1860	66.7	-	33.0	0.3	100.0	Hoffman & Ross 1974a
Fort Vancouver: Sales Shop	-	ca. 1829–1860	62.9	-	27.1	-	100.0	Hoffman & Ross 1974a
Fort Vancouver: Chief Factor's House	-	ca. 1837–1860	59.3	-	40.7	-	100.0	Hoffman & Ross 1973
Fort Vancouver: Indian Trade Store	-	ca. 1834–1860	58.3	-	34.2	7.5	100.0	Hoffman & Ross 1975
Fort Vancouver: Blacksmith Shop	-	ca. 1834–1860	49.4	-	50.6	0.0	100.0	
Rocky Mountain House	-	1799–1834	48.4	51.6	-	-	100.0	Noble 1973
Fort Vancouver: Fur Store	-	ca. 1829–1860	33.8	-	66.2	-	100.0	Hoffman & Ross 1974b
Sinclair	-	1790–1810	25.1	74.9	-	-	100.0	Moore 1983
Sitka Hospital, Feature 12	-	ca. 1860	30.1	4.8	62.2	2.8	100.0	Musitelli 1986
Willamette Mission	-	1834–1841	21.9	-	78.9	-	100.0	Sanders et al. 1983
Jones	-	1800–1860	11.4	-	88.6	-	100.0	Moore 1981
Fort Atkinson	-	1820–1827	4.4	-	95.6	-	100.0	Carlson 1979
Champoeg	Block 53	1830–1861	3.0	-	97.0	-	100.0	Speulda 1988
Champoeg	Block 12	1830–1861	1.0	-	99.0	-	100.0	Speulda 1988
Champoeg	Montcalm St.	1830–1861	1.0	-	99.0	-	100.0	Speulda 1988
Champoeg	Block 1	1830–1861	0.7	-	99.1	0.2	100.0	Speulda 1988
Pikes Bluff	-	1830–1857	0.9	-	99.1	-	100.0	Moore 1983
Arkansas Bank	-	1840–1863	-	-	100.0	-	100.0	Walker 1971
Bay Springs Millworkers' Barracks	22TS1108	1852–1885	-	-	100.0	-	100.0	Adams et al. 1981
Bay Springs Union Factory	22TS1103D	1852–1885	-	0.0	100.0	-	100.0	Adams et al. 1981
Bay Springs Millworkers' House	22TS1115	1852–1885	-	-	100.0	-	100.0	Adams et al. 1981
Bay Springs Millworkers' House	22TS1103C	1852–1885	-	-	100.0	-	100.0	Adams et al. 1981
Richland Creek	41NV254E	1870–1880	-	-	100.0	-	100.0	Jurney 1987
Richland Creek	41NV306	1875–1905	-	-	100.0	-	100.0	Jurney 1987
Harmony Borax Works:	CL	1883–1888	-	-	100.0	-	100.0	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T4A	1883–1888	-	-	100.0	-	100.0	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T4B	1883–1888	-	-	100.0	-	100.0	Teague & Shenk 1977
San Juan: English Camp, Commissary	45SJ24	1859–1970	-	-	100.0	-	100.0	Sprague 1983
San Juan: English Camp, Older Barracks	45SJ24	1859–1970	-	-	100.0	-	100.0	Sprague 1983
San Juan: English Camp, Captain's House	45SJ24	1859–1900	-	-	100.0	-	100.0	Sprague 1983
San Juan: San Juan Town	45SJ290 Op.1	1859–1872	-	-	99.9	0.1	100.0	Sprague 1983
San Juan: American Camp, Officers' Row	45SJ300	1859–1872	-	-	99.8	0.2	100.0	Sprague 1983
San Juan: American Camp, Officer's Quarter	45SJ300 Op.4	1859–1872	-	-	99.5	0.5	100.0	Sprague 1983
Bay Springs Mill Outbuilding	22TS1103B	1852–1885	-	-	99.3	0.7	100.0	Adams et al. 1981

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Total	Source
Bay Springs Millworkers' House	22TS1103A	1852–1885	-	0.0	98.4	1.6	100.0	Adams et al. 1981
Harmony Borax Works:	P	1883–1888	-	-	97.0	3.0	100.0	Teague & Shenk 1977
Harmony Borax Works: Adobe A	T2	1883–1888	-	-	96.9	3.1	100.0	Teague & Shenk 1977
Millwood Plantation	Site 1	ca. 1860–1900+	-	-	96.2	3.8	100.0	Orser et al. 1987
Millwood Plantation	Site 2	ca. 1860–1900+	0.2	-	96.0	3.8	100.0	Orser et al. 1987
Millwood Plantation	Site 7	ca. 1860–1890+	-	-	96.0	4.0	100.0	Orser et al. 1987
Bay Springs Millworkers' Barracks	22TS1109	1852–1885	-	-	95.9	4.1	100.0	Adams et al. 1981
Fort Colville: Angus MacDonald	-	1871–1907	-	-	95.6	4.4	100.0	Saastamo 1971
San Juan: English Camp, Newer Barracks	45SJ24	1859-??	-	-	93.2	6.8	100.0	Sprague 1983
Richland Creek	41NV254W	1870–1880	-	-	93.2	6.8	100.0	Jurney 1987
Millwood Plantation	Site 8	ca. 1870–1930	0.2	-	91.8	8.0	100.0	Orser et al. 1987
Kiowa/Comanche Indian Agency	-	1869-ca.1881	-	-	91.5	8.5	100.0	Crouch 1978
Waverly: Mill and Cotton Gin	22CL575	1842–1907	-	-	90.4	9.6	100.0	Adams 1980
Richland Creek	41NV145	1859–1915	-	-	83.0	17.0	100.0	Jurney 1987
Fort Bowie	-	1868–1894	14.4	-	81.3	4.4	100.0	Herskovitz 1978
Millwood Plantation	Site 23	ca. 1860–1910	0.2	-	80.6	19.2	100.0	Orser et al. 1987
Bay Springs Millworkers' House	22TS1111	1852–1885	-	-	78.6	21.4	100.0	Adams et al. 1981
Bay Springs Commissary	22TS1113	1852–1885	-	-	78.6	21.4	100.0	Adams et al. 1981
Reward Mine	Site 19	-	-	-	76.0	24.0	100.0	Teague 1980
Waverly: Henry Goodall's House	22CL571B	ca. 1890–1910	-	-	75.6	24.4	100.0	Adams 1980
Spalding: Sutler's Store	A	1869–1880	-	-	72.8	27.2	100.0	Chance & Chance 1985
Richland Creek	41NV235	1855–1905	-	-	68.1	31.9	100.0	Jurney 1987
Millwood Plantation	Site 6	ca. 1860–1890+	0.1	-	66.9	33.0	100.0	Orser et al. 1987
Spalding: frame building	B	1866–1879	-	-	65.5	34.5	100.0	Chance & Chance 1985
Spalding: Major Truax's Stable	C	ca. 1869-ca. 1879	-	-	65.5	34.5	100.0	Chance & Chance 1985
Spalding: large white building	D	ca. 1880–1902+	-	-	64.0	36.0	100.0	Chance & Chance 1985
Richland Creek	41NV102 old	1873–1945	-	-	61.0	39.0	100.0	Jurney 1987
Bay Springs Store	22TS1105	ca. 1852–1979	-	-	57.2	42.8	100.0	Adams et al. 1981
Millwood Plantation	Site 17	1890–1900+	0.2	-	56.2	43.6	100.0	Orser et al. 1987
Waverly: Belle Scott Site	22CL567	ca. 1890–1930	-	-	54.6	45.4	100.0	Adams 1980
Richland Creek	41NV267	1873–1910	-	-	54.0	46.0	100.0	Jurney 1987
Waverly: Ellen Mathews's House	22CL571A	ca. 1890–1942	-	-	52.6	47.4	100.0	Adams 1980
Bay Springs: Tobe Eaton	22TS1504	ca. 1894–1980+	-	-	47.7	52.3	100.0	Smith et al. 1982
Richland Creek	41FT143	1895–1953	-	-	47.2	52.8	100.0	Jurney 1987
Skagway: William Moore Cabin	-	1888–1900	-	-	41.2	58.8	100.0	Blee 1988
Richland Creek	41NV102 new	1873–1945	-	-	38.0	62.0	100.0	Jurney 1987
Millwood Plantation	9EB253	1860–1870	-	-	37.0	63.0	100.0	Orser et al. 1987
Richland Creek	41NV101	1877–1940	-	-	31.0	69.2	100.0	Jurney 1987
Bay Springs: James T. Butler	22TS995	ca. 1870–1980+	-	-	30.2	69.8	100.0	Smith et al. 1982
Silcott: Ireland Place	45AS87C	1884–1927	-	-	30.0	70.0	100.0	Adams 1977
Harmony Borax Works: Adobe B	T3	1883–1888	-	-	23.2	76.8	100.0	Teague & Shenk 1977
Reward Mine	-	-	-	-	20.9	79.1	100.0	Teague 1980

Site Name	Site Number	Date Range	Wrought	Early Machine	Machine	Wire	Total	Source
Millwood Plantation	38AB12	1900–1930	-	-	19.9	80.1	100.0	Orser et al. 1987
Bay Springs: Nancy Belle Holly	22TS1502	1904–1980+	-	-	15.0	85.0	100.0	Smith et al. 1982
Skagway: Bernard Moore House	-	1900–1914	-	-	13.8	86.2	100.0	Blee 1988
Waverly: Aaron Mathews's	22CL569	ca. 1909–1970	-	-	9.7	90.3	100.0	Adams 1980
Silcott: Bill Wilson's Store	45AS87A	1910–1928	-	-	5.2	94.8	100.0	Adams 1977
Richland Creek	41NV253	1910–1940	-	-	4.0	96.0	100.0	Jurney 1987
Silcott: Trapper Wilson's House	45AS87B	1900–1930	-	-	3.3	96.7	100.0	Adams 1977
Reward Mine	Site 44	-	-	-	3.0	97.0	100.0	Teague 1980
Bay Springs: John Eaton	22TS1505	ca. 1894–1952	-	-	2.9	97.1	100.0	Smith et al. 1982
Bay Springs: Ezra Searcy	22TS568	ca. 1900–1980	-	-	2.6	97.4	100.0	Smith et al. 1982
Richland Creek	41NV251	1890–1955	-	-	2.5	97.5	100.0	Jurney 1987
Skagway: Peniel Mission	(gold rush)	1897–1900	-	-	1.4	98.6	100.0	Rhodes 1987
Bay Springs: Tipton/O'Neal	22TS1506	ca. 1909–1980+	-	-	1.4	98.6	100.0	Smith et al. 1982
Richland Creek	41NV147	1910–1940	-	-	1.4	98.6	100.0	Jurney 1987
Bay Springs: R.G. Adams	22TS1507	1913–1980+	-	-	0.9	99.1	100.0	Smith et al. 1982
Richland Creek	41NV316	1900–1950	-	-	0.8	99.2	100.0	Jurney 1987
Richland Creek	41NV285	1895–1955	-	-	0.7	99.3	100.0	Jurney 1987
Richland Creek	41NV289	1898–1965	-	-	0.4	99.6	100.0	Jurney 1987
Silcott: Ferry Tender Site	45WT104	1910–1930	-	-	0.1	99.9	100.0	Adams 1977
Bay Springs: Billie Eaton	22TS1503	ca. 1905–1980+	-	-	-	100.0	100.0	Smith et al. 1982
Richland Creek	41NV258	1915–1960	-	-	0.0	100.0	100.0	Jurney 1987

TABLE 6
RANGES OF MACHINE CUT NAILS

Range	Highest %	Lowest %
1790–1809	74.9	51.4
1810–1829	66.2	13.4
1830–1867	100.0	78.6
1868–1879	100.0	81.3
1880–1889	100.0	23.2
1890–1899	75.6	0.1
1900–1915	15.0	0.0

few machine cut nails in a context probably related to U.S. Army building during World War II (Blee 1983:82–88).

Summary

With the data presented here, researchers should have a better idea when structures were built. Well-dated sites that do not fit this model should be re-examined from the standpoint of recycling, time lag, differences in access to markets, and British vs. American sources. Once those have been evaluated, the model can and should be further refined. Of particular importance is the recognition that places supplied by British manufacturers will have wire nails from the 1860s onward, while those supplied by American manufacturers will not have wire nails until after about 1884. Can the two be distinguished on the basis of metallurgy?

While the model provides a gross means of dating sites, it clearly must be used with caution and supportive data from other sources, when these are available. The model also has particular utility in dating ephemeral sites, particularly in the West. Places like homestead cabins, logging camps, and prospectors' cabins may last too short a time and have been occupied by people too poor in material culture to produce satisfactory artifact dates. Using this model provides at least some notion of the construction date for the site.

If historical archaeologists would use this model in conjunction with other methods, a better understanding of a site's history may be gained. While certainly needing to be used with some caution and thought, this model provides a useful tool for site interpretation.

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