The National Park Service in its historic structures restoration program has developed some research techniques in the general field of nail chronology as an aid to dating old buildings. This paper was prepared for a National Park Service Historic Structures Training Conference held in July, 1962. The paper was published, along with a paper on “Paint Color Research and Restoration” by Penelope Hartshorne Batchelor, as Technical Leaflet 15 in the December, 1963, issue of History News. The Nail Chronology paper has been revised, and put in the new format, and published here in the hope that it will continue to be of use to other restoration projects and that it will stimulate further contributions to these studies. The Paint Color Research paper was revised and reprinted by itself as Technical Leaflet 15.

Dating old buildings from their nails is not a precise technique, but when used with discretion, it has proved generally reliable and useful, for example, in Independence Hall which has been subjected to a complex series of alterations from 1750 to the present time. If a sufficient number of samples are taken from all parts of the building they can be a good indication that (1) the building was built entirely at a given time, or (2) the building has been subjected to additions, alterations, or simple maintenance measures. Nails can help to define the extent of these changes. For this reason we believe it worthwhile to discuss briefly the various nail types that are generally found in American buildings. They are (1) hand-wrought nails, (2) cut nails, and (3) wire nails. Within these major groups there is a surprising variety with subtle differences.
in type which enable us to use nails as
dating tools with some certainty.'

HAND-WROUGHT NAILS

The study of wrought nails, while
interesting, has its limitations for they
were used throughout the seventeenth
and eighteenth centuries and even into
the early nineteenth century. For this
period other factors (especially deco­
orative details, hardware, etc.) are better
indicators of "period." However, it is
useful to become familiar with wrought
nails for purposes of identification and
comparison with other nail types.

In medieval England nails were made
into a great variety of special shapes
and sizes and sold by the hundred, e.g.,
8d (pence) per 100 nails. From this
practice developed the classification of
nail sizes according to their price per
hundred, a system which seems to have
been established by the fifteenth cen­
tury. After that time nails slowly be­
came standardized by size rather than
price. In 1471 for example, "fippenynayl!" were only 4d per 100. In 1477
"xpenynaylll" were only 8d per 100; and
in 1494 "sixpenynayle" were 5d per 100.

During the entire Colonial period nails
were an important commodity for im­
portation. In 1684 for example, James
Claypoole (recently arrived in Philadel­
phia from London) wrote to a London
merchant as follows: "... send no win­
dow glass nor lead, but Iron is much
wanted, and nayls very much vizt 6d 8d
& 10d a Tunn of each sort would quickly
sell, I conclude." The scarcity of nails
in colonial Virginia was reflected in a
statute enacted in 1645 to prohibit
settlers from burning down old buildings
for their nails. Some nails were made
in the colonies in the seventeenth and
eighteenth centuries, but despite this
local production very large quantities of
nails were imported during the same
period.

During and after the Revolution,
America became more dependent upon
local sources for the supply of nails.
Perhaps a typical nailery was that op­
erated by John Little in Philadelphia in
late 1770's (during the British occupa­
tion). His manuscript "Account of
Smiths and Nailors Work . . ." includes a
variety of things like kettles, chain, tools,
etc., but primarily covers the manufac­
ture of nails in sizes varying from 3d
to 30d. John Little had several dozen

'This paper does not encompass tacks or
screws. Although they are interesting sub­
jects, they are not especially useful in
dating old buildings except in a very gen­
eral way. Machine-cut tacks were perfected
at an early date and thus not helpful as a
dating tool, nor can they readily be identi­
fied as an original and integral part of a
building. Machine-pointed screws with
constantly tapered threads seem to have
been introduced in the 1830's, but they are
not a reliable indication of date because of
their limited use in building construction.

'Louis Salzman, Building in England (Ox­
ford, 1952), 315.
It is important to emphasize that wrought nails continued to be used for several decades following the introduction of the cheaper cut nails. In the 1820s Philadelphia newspaper advertisements of “Nails, Brads and Spikes” often included both cut and wrought nails with prices for each in their respective sizes. Wrought nails continued to be superior for certain purposes, especially where they required clinching or for trim work. For this reason it is not uncommon to find a few hand-wrought nails used well into the nineteenth century. It is interesting that many buildings of this period utilized both wrought and cut nails in their original construction. The Old Town Hall (built 1798-1800) in Wilmington, Delaware, for example utilized hand-headed machine-cut brads for flooring and crude, machine-cut lath nails, but all the finish woodwork was held with wrought nails.

The several characteristics of wrought nails are illustrated in the drawing in the center of this Leaflet. Included is a cast nail which perhaps does not properly belong in this group but is known nails, etc. Catalog No. E.121-1896, Old English Pattern Books of the Metal Trades, Victoria and Albert Museum, Pub. No. 87 (1913), 32-33.
MACHINE-CUT NAILS

In 1923, Dr. Henry C. Mercer's pioneer study on cut nails was included in a published essay entitled *The Dating of Old Houses* (New Hope, Pennsylvania). Others, including the writer, have only built upon Mercer's early work; however, much research remains to be done in this field.

The study of cut nails is especially useful where late eighteenth and early nineteenth century buildings or alterations are involved. The period 1790-1830 encompasses a remarkable technological transition from wrought to cut nails. After the Revolution, many cut nail manufactories were established in New England, New York, New Jersey, and Pennsylvania. These were at first operated by hand power and later by water or steam power. America seems to have been leading the English in this particular field.

Authorship for the initial invention and specific improvement of cut nails remains largely anonymous. Certain individuals are known to have received patents during the 1780s-90s, but the precise nature and significance of their work are not fully documented.

Casting nails are illustrated in a late eighteenth century English hardware catalog, and there is an 1829 reference in Bishop, *A History of American Manufacturers* (Philadelphia, 1864), Vol. II, 341. Several excellent specimens of cast-iron nails were supplied to the writer (in 1967) by J. R. Stevens, from a recently demolished c.1820 building in Halifax, Nova Scotia. The sketch and observations regarding cast nails, which accompany this paper, were partly based on the samples generously given by Mr. Stevens to the author.
inventions remains rather vague.\textsuperscript{9}

Unfortunately the Patent Office Record's fire of 1836 destroyed a vast amount of primary source material with respect to the invention of cut nail machines. Some of this information has been collected and appended to the scholarly biography \textit{Jacob Perkins} by Greville and Dorothy Bathe.\textsuperscript{10} This book

\textsuperscript{9}For mention of a sixteenth century "instrument for making of Nails," see Greville and Dorothy Bathe, \textit{Jacob Perkins, His Inventions, His Times, and His Contemporaries} (Philadelphia, 1943), 172, but it seems unlikely that this was in any way related to a cut nail machine.

\textsuperscript{10}For a more complete listing of inventions and events relating to the evolution of nail-making, see H. R. Bradley Smith, "Chronological Development of Nails," supplement to \textit{Blacksmith's and Farriers' Tools at Shelburne Museum} (Shelburne, Vermont, 1966). See also a general history of nail-making by Arthur S. Tisch, "Modern Wood Construction, only as good as its fastening!" reprinted as Bulletin No. 1, by the American Society of Precision Nailmakers, 630 Third Avenue, New York.
Hand-wrought nails - types commonly used in 17th, 18th, 19th c. American building construction

General purpose nails - for framing, lathing, and most concealed work, sometimes for rigging, or where head was used for decorative effect. Other shapes were available for special purposes, i.e., clapboard nails, boat nails, coffin nails, etc. Wrought nails continued to be used long after the introduction of cut nails, but generally such use was limited to situations where their superior clinching ability was needed (i.e., rotten doors).

Sprigs and brads: These names were often confused or used inconsistently; but they generally refer to headless, or L-head or T-head nails. Smaller sizes were usually called "sprigs," e. g. to 2", usually sold by quantity. Larger sizes were usually called "brads," 4d to 24d, usually sold by weight. These nails were generally used for trim with heads countersunk and filled, also used for flooring.

Other characteristics of hand-wrought nails - shanks usually taper on both faces; iron fibers run lengthwise, lack of uniformity (especially heads).

Early machine-cut nails with handmade heads

<table>
<thead>
<tr>
<th>Common Nails</th>
<th>Sprigs and Brads</th>
<th>Lathe Nails</th>
</tr>
</thead>
<tbody>
<tr>
<td>(very early 18th c)</td>
<td>(late 18th c)</td>
<td>(late 18th c)</td>
</tr>
</tbody>
</table>

Heads usually have 2 facets, sometimes more. Heads in tool like wrought nails. Earliest nails of this type usually have section A; latter ones usually have section B and are more uniform in manufacture.

Size and shape of heads vary because heads were forged, smaller sizes called sprigs (2" or less), and larger sizes called brads, but by early 19th c., all were often called brads.

Heads vary in size and shape, usually thin and flat (no facets), and eccentric to shank. Shank varies in length and width and often have a sharp point, eg. under head often present.

Early completely machine-cut sprigs and brads available in a variety of sizes. Curved corners and points are characteristic of this type.

Perfected machine-cut sprigs and brads were much used for trim and flooring. Once perfected, they have changed little, and are not readily distinguishable except that the direction of iron fibers offers a general clue. See sketch above. Beveled facets caused by pressure of die, often missing on small nails.
The sets of nail drawings on these two pages are organized together so that the user will have a visual comparison when he is trying to identify a nail. The cast nail in the right hand corner of the upper drawing on the opposite page may not properly belong in the group but it is known to have been used in the eighteenth century and well into the nineteenth.
what an additional title of nobility or
the ensigns of a new order are in
Europe." 11

One of the earliest cut nail machines
in Pennsylvania, was one built by
William J. Folsome at Harrisburg in
1789. Folsome (lately from New
Hampshire) was producing 120,000
nails per week in March of that
year.12 Cut nails made in the 1780s
undoubtedly exist, but the writer has not been suc­
scessful in locating any unquestionably
dateable specimens that predate the early 1790s.

In Philadelphia and Trenton, nails
were manufactured using prison labor.
Jacob Hiltzheimer notes in his diary for
7 March 1797, "went from the State
House with John Shoemaker, of the
House, and about a dozen members, to
the [Walnut Street] gaol, to see the
prisoners at work at different trades. We
saw six men cutting nails, and twelve
making heads to them . . ." [italics sup­
plied]. References to the making, sale,
and use of cut nails are numerous after
the late 1790s.

The development of cut nail manu­
factoring and their use is marked by at
least five distinct phases and the evolu­
tion of cut nail types may be roughly
outlined as follows:

1. Cut from Common Sides, 1790s-1820s
   Hammered Heads
2. Cut from Opposite Sides, 1810-1820s
   Hammered Heads
3. Cut from Common Sides, 1815-1830s
   Crude Machine-Made Heads
4. Cut from Opposite Sides, 1820s-1830s
   Crude Machine-Made Heads
5. Cut from Opposite Sides, late 1830s to
   Present
   Machine-Made Heads

Even the simplier machines continued
to be used long after the more sophis­
ticated machines were developed, which
creates overlapping in the above chro­
nology. It will be noted that this se­
quence is contrary to Mercer's theory
that (1) early cut nails were sheared
from opposite sides, and (2) later nails
were cut from common sides. From an
inspection of cut nail "shear marks,"
Mercer's theory seems correct. Surpris­ingly enough, nails cut from a common
side have "shear marks" on their oppos­ing sides (see Figure 6).18 It should also
be noted that until the 1830s most cut
nails are also distinguished by the fact
that the iron fibers run crosswise to the
shank while later cut nails have a fiber
structure parallel to the shank (see
drawing). For this reason early cut nails
could not be satisfactorily clinched and
wrought nails continued to be preferred
for clinching.

To use cut nails as a dating tool,
several factors must be considered:

1. Identification of the cut nail type
   must be precise.
2. When did that nail type become
   available in the area?
3. When was that nail type supe­
   rcended by a "better" cut nail?
4. Are there similar cut nails in dated
   houses of the same locale?
5. The existence of several cut nail
   types in the same building might indi­
   cate a transition period of nail im­
   provements, or alterations within the build­

11Edwin M. Betts, ed., Thomas Jefferson's
   Farm Book (Princeton, 1953), 426.
12This and several important related items
   were brought to the writer's attention by
   Hannah Benner Roach of Philadelphia.

18The writer is indebted to Donald
   Streeter, blacksmith and collector, of Iona,
   New Jersey, for calling attention to this
   fact.
ing. Note: Cut nail improvements were first applied to the smaller sizes. For example, lath nails were perfected before the larger framing nails.

6. No attempt should be made to date a building on the basis of a single nail.

7. Cut nails manufactured after c. 1830 are virtually indistinguishable from those made today.

8. Wrought nails were competing with cut nails until at least 1820.

9. Some naileries were contemporaneously offering a more advanced product than others. For example, in 1820 Pierson’s nails (New York) were considered superior to those made at the Phoenix Works (Pennsylvania).

10. Urban areas responded to improved products more readily than did rural areas. The foregoing generalizations and dates are tentative and subject to correction and contributions by others interested in the subject.

In general, the study of cut nails has been quite useful in distinguishing alterations within Independence Hall. In the Assembly Room for example, extensive changes took place both in 1816 and 1831, but the evidence is easily discernible because of the vast improvement in cut nails in the interval.

WIRE NAILS

The introduction and development of wire nails has not been adequately studied. It appears that several manufactories were established in New York during the 1850s, following an earlier development in England, France, and Germany. The first American production of wire nails was from machines either imported or adapted from existing European models. The earliest wire

\[ \text{Clark, History of Manufactures in the United States (New York, 1949), Vol. I, 518. See also the transcript of an unidentified magazine article (dated 23 April 1896) by John Hassall, entitled “The Early} \]
nails were not made for building construction, but rather in the smaller sizes for pocket book frames, cigar boxes, etc. American wire nail machinery was not really perfected until the 1860s and 70s. Machinery for this product was exhibited at the Philadelphia Centennial Exposition of 1876.\footnote{"Official Catalogue of the U.S. International Exhibition (Philadelphia, 1876), "Dept. of Manufactures," 137 and passim.}

An 1888 article which deals mainly with cut nails, comments on the "newer" type:

"Nails of a very different kind, manufactured from steel wire, have been in use for a number of years in America and for a longer period in Europe, and in both places they have been very favorably received and are fast superseding the common cut-nails for many purposes."

Several advantages were claimed and thirteen different varieties were illustrated in this article.\footnote{"Builders' Hardware—III. Nails," The American Architect and Building News, Vol. XXIV, No. 660 (18 August 1888), 73.} By this time wire nails were definitely in the builders' vocabulary and they were made in sizes ranging from 2d to 60d.

Wire nails did not supplant cut nails with the rapidity that wrought nails were replaced. The transition was more gradual. Wire nails did not really become the dominant type until the 1890s, and many builders preferred using cut nails well into the twentieth century. The greater holding power of cut nails was certainly a factor which delayed the quick acceptance of wire nails. In the
1880s, a series of experiments on the adhesion of nails was carried out by the Watertown Arsenal, Massachusetts. These tests confirmed this advantage, but the relative cheapness, ease of handling and the variety of specialized wire nails gave them a gradually increasing preference. The earliest wire nails can be distinguished from their modern counterparts by their "heads" being bulbous and generally eccentric with respect to the shank. There is not the clearly defined evolution of development that makes the cut nail so useful in dating buildings. As a generalization, the presence of wire nails indicates late nineteenth century repairs, alterations or maintenance, and to that extent they are useful "dating tools." Although wire nails are in common usage today in a multitude of varieties, cut nails continue to be used by some carpenters for specific functions, such as flooring nails, boat nails, and masonry nails.

W. Carroll, restoration architect, National Park Service.
Hand-wrought nails were turned out at forges such as this two-man forge operated by a blacksmith at Old Sturbridge Village, Sturbridge, Massachusetts. Latches, hinges, candlestands, foot scrapers, toasting forks, and a myriad of other objects were made by smiths at these forges of yesteryear. (Photo: Old Sturbridge Village.)

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For this part of the revision of the original Technical Leaflet 15, Lee H. Nelson did the whole set of new drawings except the front page drawing by G. Dyser.