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NOTES ON THE CARTLAND HOUSE LEE, NEW HAMPSHIRE

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The following notes on the Cartland House in Lee derive from a brief inspection of the house on the afternoon of July 23, 2007. Also present at the inspection were Laura and John Gund. The purpose of the inspection was to determine the cause of some deterioration to the northern chimney of the house. We inspected both chimneys to determine their treatment over the years and their current condition. The notes below also include a few observations on the apparent history and evolution of the house, based on casual and unsystematic observation of some stylistic and technological features of the building during the course of inspecting the chimneys. Our inspection did not include an examination of a number of the rooms in the house, and entailed only a brief inspection of the roof framing, which has much to reveal about the evolution of the building.

Northern chimney: The northern chimney of the Cartland House appears to date from the early 1800s. As noted below in a discussion of the apparent evolution of the house, the northern portion of the present dwelling appears to have been added to an older, L-shaped house between about 1800 and about 1830. The northern chimney was added at this period to convert the former dwelling into a "double" (two chimney, central entry) house, accommodating a parlor fireplace in the eastern room and a kitchen fireplace in the western or rear room. (We did not examine the second-story rooms.)

This chimney is not presently used for fires or to vent a furnace. It has reportedly been capped with a plate of stainless steel.

This chimney was apparently repaired at a time when the companion southern chimney was totally rebuilt. Repairs to the northern chimney used methods and materials that matched those used in the wholesale rebuilding of the southern chimney. According to Laura Gund, there is a strong likelihood that this work was carried during the period when the Cartland House was owned and used as a summer home by Fred Engelhardt, who served as president of the

University of New Hampshire from 1937 to 1944. For the purpose of approximating the date of alterations to the house under the Engelhardt ownership, we may estimate the time of these changes at circa 1940.

Repairs to the northern chimney included rebuilding the fireboxes in each fireplace with modern bricks laid in mortar that contains a high proportion of Portland cement. New steel lintels were applied above each fireplace opening, and soft, older bricks were apparently salvaged and applied at the jambs of the fireplaces to retain an antique appearance. To judge from an inspection in the basement and attic, the chimney stack was otherwise left in original condition. For the most part, the unaltered portions of this chimney are typical of the era of original construction. This chimney stands on two brick piers spanned by heavy wooden planks below the level of the first-floor hearths. The bricks are laid in clay-sand mortar above the basement and below the roof.

The uppermost portion of the chimney, starting just below the roof and originally extending to the top of the chimney, was laid in lime-sand mortar. This portion of the chimney was later parged (coated with a thin application of mortar) to seal joints that were leaking creosote.

Above the roof, the repairs of circa 1940 entailed the re-laying of the chimney stack in mortar with a high proportion of Portland cement in the same manner that the fireboxes below were rebuilt. It was impossible to tell from ground-level observation whether original bricks were utilized in the rebuilding above the roof, but the condition of the chimney suggests that old bricks were employed for the most part.

High-Portland mortar (so called) is too hard for use with old bricks that were burned at the relatively low temperatures achieved in scove kilns of the eighteenth and early nineteenth centuries. There is much literature on this subject, but the summation of most of what has been written can be stated succinctly. Because it has a higher compressive strength than the bricks to which it is applied, and because both bricks and mortar shrink and swell imperceptibly with changes in moisture and temperature, high-Portland mortar causes historic bricks to spall or break. Spalled and broken bricks are visible in the northern chimney, and in places the mortar beds remain intact above or below voids that were left when bricks have partly fallen away. The survival of the mortar and the disappearance of the adjacent bricks is clear proof that the present mortar is harder than the bricks.

The movement of bricks and mortar, probably exacerbated by frost action in a cold and damp chimney, has caused the stack to bulge somewhat at its northeastern arris or corner, as may be seen from the ground.

Because the accumulation of moisture in the capped chimney may lead to frost damage in cold weather, it is also important that mortar employed with relatively soft bricks have a greater permeability to water vapor than the bricks. This will allow moisture within the masonry mass to migrate outward toward conditions of lesser relative humidity without forcing the bricks themselves to serve as the routes of migration of the water vapor and thus to retain water within them. High-Portland mortars are generally less permeable than the adjacent bricks, forcing water

vapor within the chimney to migrate outward through the bricks and thus exposing the bricks to the danger of frost damage due to high moisture content.

None of the deterioration seen in the north chimney is unusual under the circumstances, nor is it immediately threatening to the chimney, but it should be corrected. The recommended method of correcting the situation is to dismantle the upper portion of the stack to a point in the attic where clay mortar ends (perhaps two feet below the roof), and to re-lay the bricks in soft, lime-sand mortar with little or no Portland cement added to the formula.

Because some bricks have been damaged by the present mortar, and because removing that hard and tenacious mortar from the remaining bricks may be difficult, it should be expected that there will be some further loss of bricks during dismantling of the chimney. John Gund pointed out a stack of old bricks behind the house. Depending on their size (old bricks vary considerably in dimensions), hardness, and present condition, some of these stored bricks may be useful in repairing the northern chimney. It will be important to use only well-burned bricks, of average (or greater than average) hardness for old bricks, in an exposed location above the roof.

The type of mortar to be employed in re-laying the chimney should be a formula that has a lesser compressive strength than the bricks it holds. The original mortar employed in the Cartland House in the cellar and above the roof would have been a mixture of lime and sand, with no other cement than the lime. While some present-day masons may choose to mix such a mortar based on their experience, others may prefer to be guided by specifications issued by an entity like the Brick Industry Association. If the latter method is preferred, then the recommended type of mortar should be no harder than "Type O," although the formula may be softer or weaker than Type O if preferred. Type O mortar develops a compressive strength of approximately 350 pounds per square inch (p.s.i) in 28 days.

Type O mortar may be mixed according to the following formula:

1 part Portland cement
2 parts mason's hydrated lime or lime putty
6¾ to 9 parts clean, sharp sand
Mixed with clean, potable water

If it is preferred to omit all Portland cement from the mixture, the formula recommended by the National Park Service and others is:

1 part mason's hydrated lime or lime putty
2¼ to 3 parts clean, sharp sand
Mixed with clean, potable water

When the chimney was rebuilt above the roof, the lead flashing that is mortared into the joints of the chimney appears to have been simply turned down, folded out onto the roof, and interlaced with the shingles, as shown on the following drawing at the right. This method of flashing, although common, is often a cause of leaks around the sides of a chimney.

The recommended method of flashing a projection through as roof is shown on the following drawing at the left. This method uses two entirely independent systems of lead flashing sheets: cap flashing and base flashing. The base flashing is placed under each course of shingles, projecting well out onto the roof, and is folded up against the side of the chimney stack. The cap flashing, mortared into the joints of the chimney, is folded down over the base flashing, covering the vertical portions of the base flashing. This method prevents water from penetrating the juncture of roof and chimney even in torrential rains. The metal that is traditionally used in such flashing is sheet lead, which is soft, pliable, long-lived, and poses no health hazard in its metallic form. Copper or lead-coated copper may be substituted, but are stiffer and somewhat harder to use.

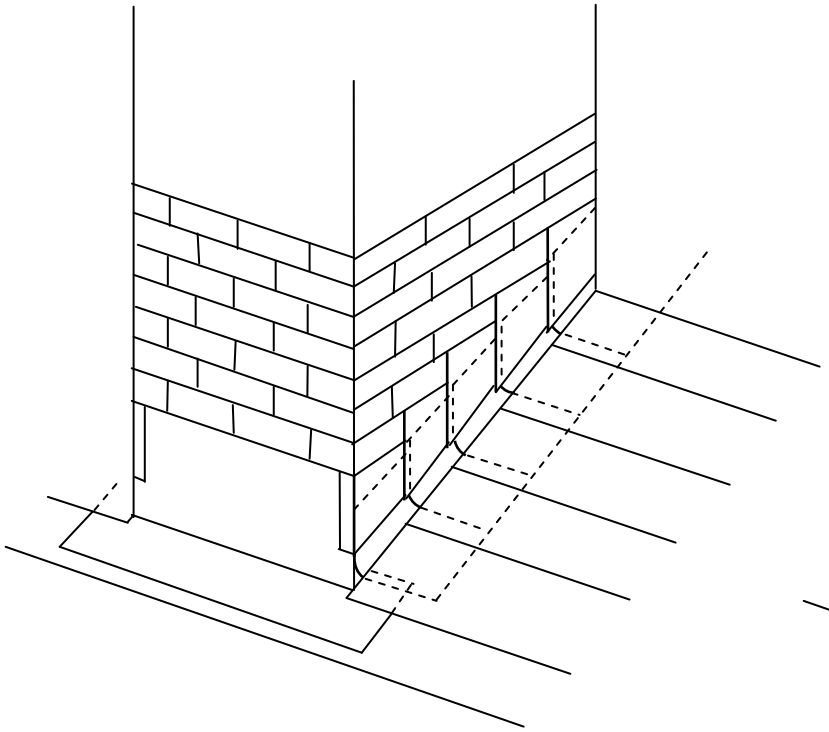
An advantage of this double system of flashing is that it permits the wooden frame of the roof to shrink, swell, and flex independently of the almost immovable chimney without straining the flashing metal. This provides longer life for the flashing and makes the reinstallation of the flashing system easier and more resistant to leakage during periodic re-roofing of the house.

Both the northern and southern chimneys currently terminate with no corbelled brick cap. While such caps are purely ornamental and serve no functional purpose, the rebuilding of the northern chimney above the roof would provide an opportunity to consider recreating the type of cap that would probably have been employed. Such a cap may be documented in older photographs. A typical cap of this type is shown in the second drawing, below.

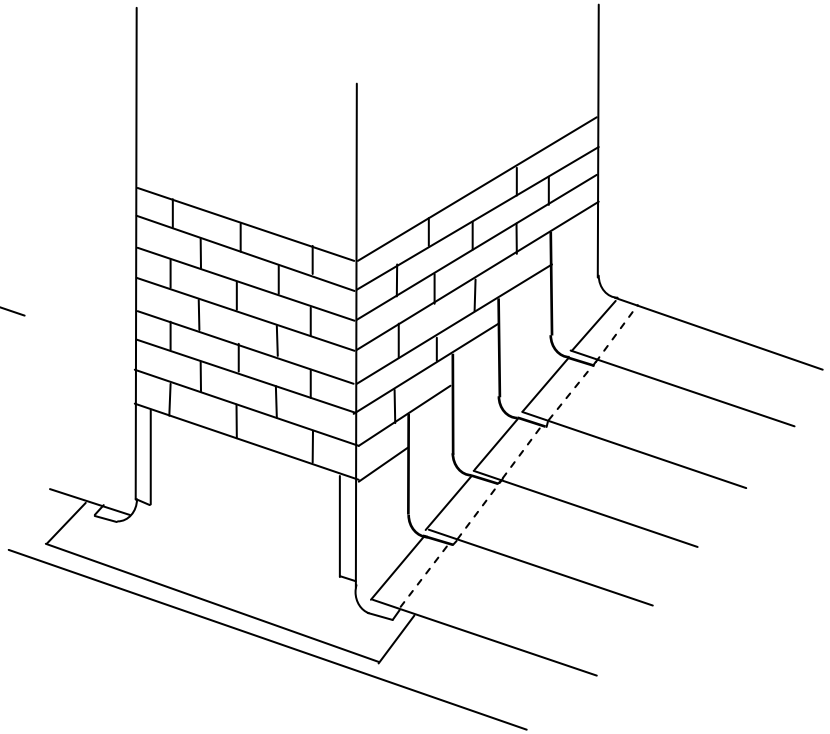
Given the likelihood that some of the spalling of the bricks in the upper part of the northern chimney has been caused by freezing and expansion of water in the masonry, some consideration might be given to improving the ventilation of the stack. Since the chimney is covered by a stainless steel plate, there is presently no easy route for condensation that may form within the chimney to escape, especially given the presence of dense high-Portland mortar in the joints.

As noted above, the substitution of lime-sand or Type O mortar in the rebuilt section of the chimney will improve the permeability of the masonry mass above the roof. But some consideration might also be given to providing a screened vent at the top of the chimney, at some unobtrusive point below the steel cap, that would encourage convection currents within the flues and would allow moisture carried upward by such currents to exit the chimney directly.

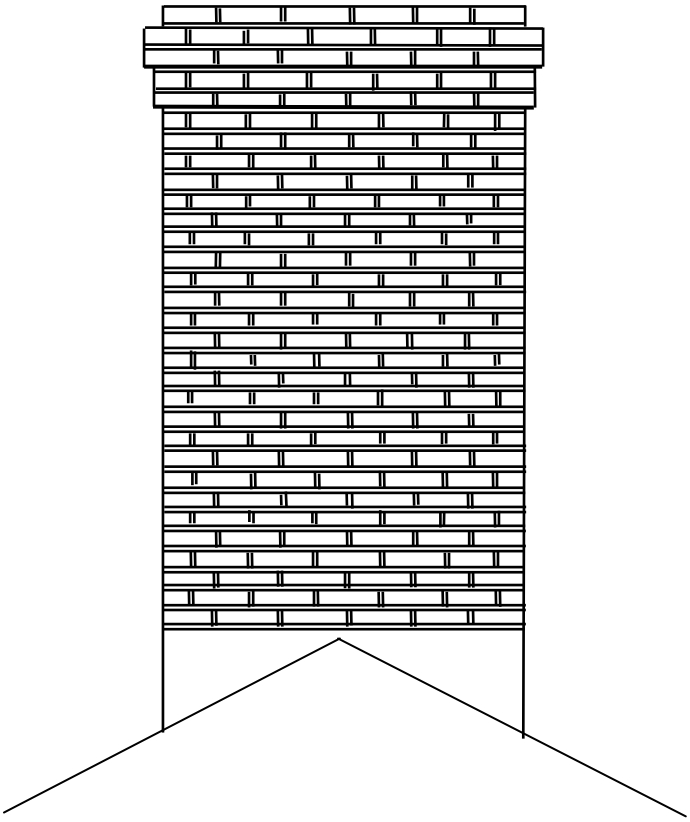
Southern chimney: The functioning chimney of the house is the southern stack. We examined this chimney briefly, and determined that it has been rebuilt completely, presumably circa 1940. As rebuilt, this chimney utilized old bricks, undoubtedly salvaged from the original stack, as a veneer on the side of the chimney base in the cellar, where a basement fireplace was replicated. Similarly, old bricks were employed at the jambs and lintels of the fireplaces. As rebuilt, this chimney was supplied with terra cotta flue liners, and presumably the configuration of the existing flues differs considerably from the original flue arrangement.



Cap and base flashing
(good method)



Flashing tucked under shingles
(poorer method)

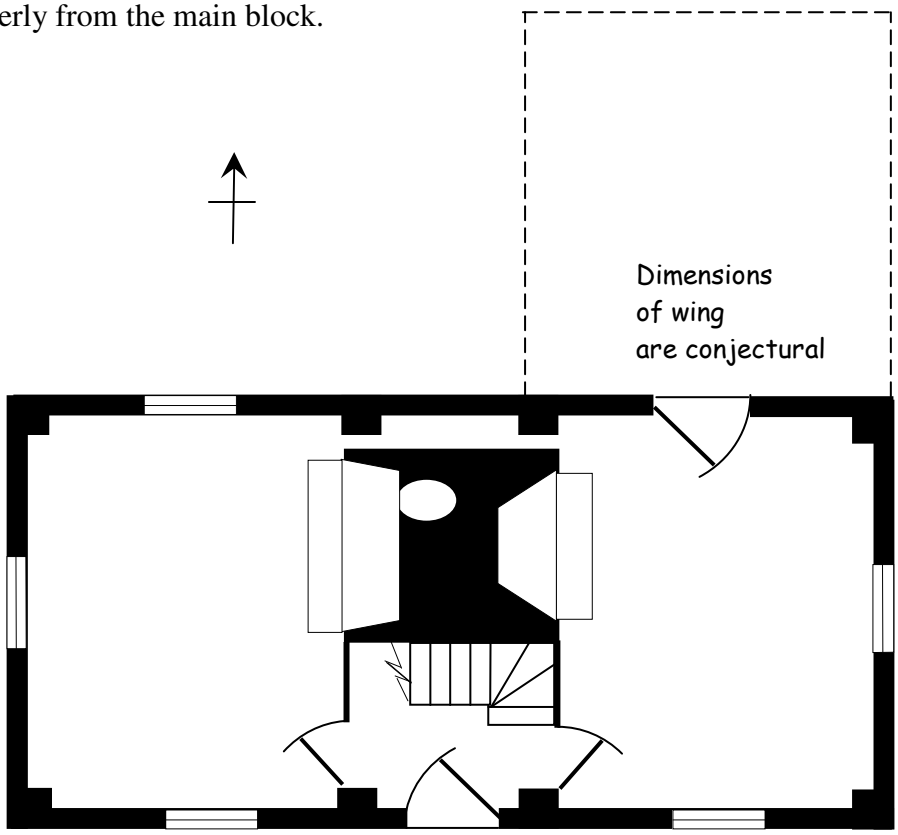


Typical chimney cap:
two courses corbeled out about ½ inch,
two more courses corbeled out ½ inch beyond that,
and one cap course brought back into
alignment with the main stack,
usually covered with a "wash" of
mortar or cement to shed water.

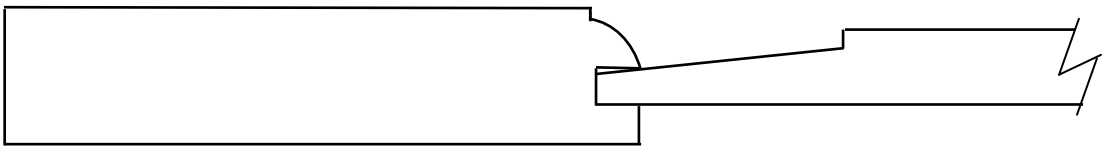
Evolution of the house: The brief inspection of July 23, 2007, did not include a number of the rooms in the dwelling, and provided only a brief opportunity to inspect the roof framing, interior joinery, and other diagnostic features that potentially could clarify the evolution of the building. Yet it is clear even from this brief inspection that the house exhibits at least three periods of construction: its origins in the eighteenth century, its enlargement and reconfiguration in the early 1800s (when the northern rooms were added, together with the chimney that is discussed above), and the period around 1850, when the house was underpinned with split stone, the southern entrance was remodeled in the Greek Revival style, and the roof frame above the northern rooms was replaced for some reason yet unknown.

Family tradition reportedly states that the earliest portion of the Cartland House, the southern section, was built by Joseph Cartland circa 1745. The house was reportedly enlarged by Joseph's son, Jonathan, who also increased the family land holdings. To judge from physical evidence, Jonathan's enlargement of the house apparently took place in the early 1800s. No available source of information speaks of the third remodeling, carried out circa 1850. At that period the property was owned by Jonathan Cartland, Jr., Joseph's grandson and a brother of Moses Cartland, a noted writer, editor, and teacher. The Cartlands of this generation were members of the Society of Friends and were strong abolitionists who are believed to have made the house a "station" on the Underground Railroad.

To judge from the remaining roof frame, the original Cartland House was a two-story, center-chimney dwelling, one room deep. The house faced south, and the eastern end of the roof frame indicates that the building had a hip and that it was L-shaped in plan, as shown below. There is no way to determine whether the house had a second chimney at some location in the wing that extended northerly from the main block.

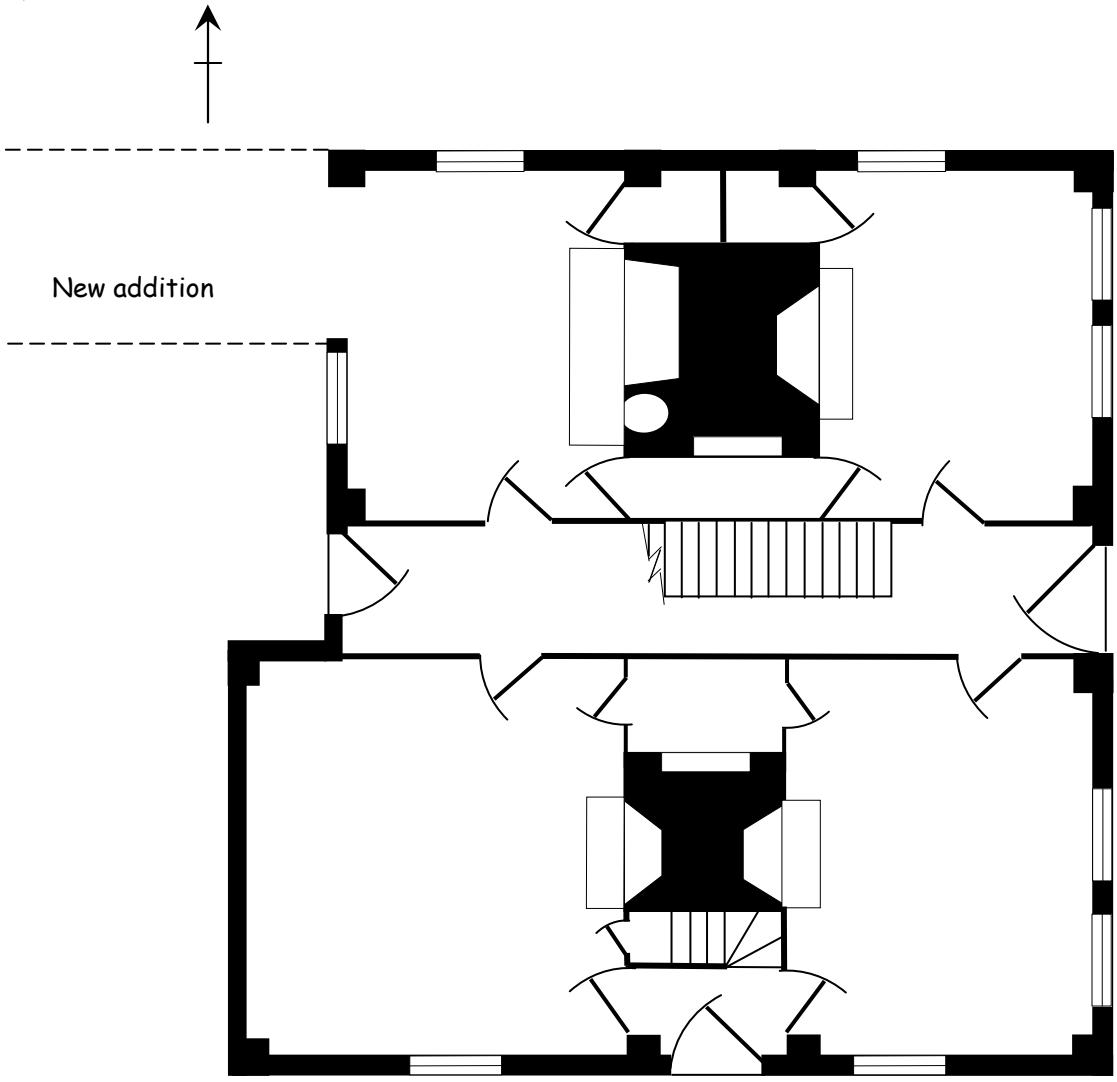


Relatively little of the interior joinery remains from the 1700s. The southern end of the house retains a few doors with the panel cross-sections shown below, but otherwise the interior of the dwelling is characterized by woodwork of the early 1800s or of the 1840 period, as described below.



Characteristic cross section of an eighteenth-century door

The roof frame above the older section of the house is a rafter-and-purlin frame with a hip rafter at the southeast corner and a kingpost beneath the apex of this rafter. The purlins extend northerly along the eastern slope of the roof until they reach the early nineteenth century addition. There, the old roof frame has been cut away, and is replaced by a roof of common rafters, as described below.



Current floor plan, drawn from memory and based partly on conjecture

Enlargement of the house, reportedly carried out by Jonathan Cartland, may be dated between 1800 and 1830 on the basis of the delicate and characteristic federal style woodwork in the north end of the house, especially that of the northeastern parlor. This joinery was not studied closely, but appears to derive from a date closer to 1800 than to 1830.

As shown above, the enlargement of the house transformed the relatively small original house into a large "double" house with two chimneys, a central stairhall, and a new principal entrance that faces east. The doors, window shutters, molding profiles, and other features of this portion of the house are characteristic of joinery of the early 1800s as seen throughout the coastal region of New Hampshire. The balustrade of the new central staircase has a slender newel post that strongly expresses the delicate aesthetic of the style of the early 1800s. The eastern entrance doorway or "frontispiece" is also characteristic of the federal period of architecture.

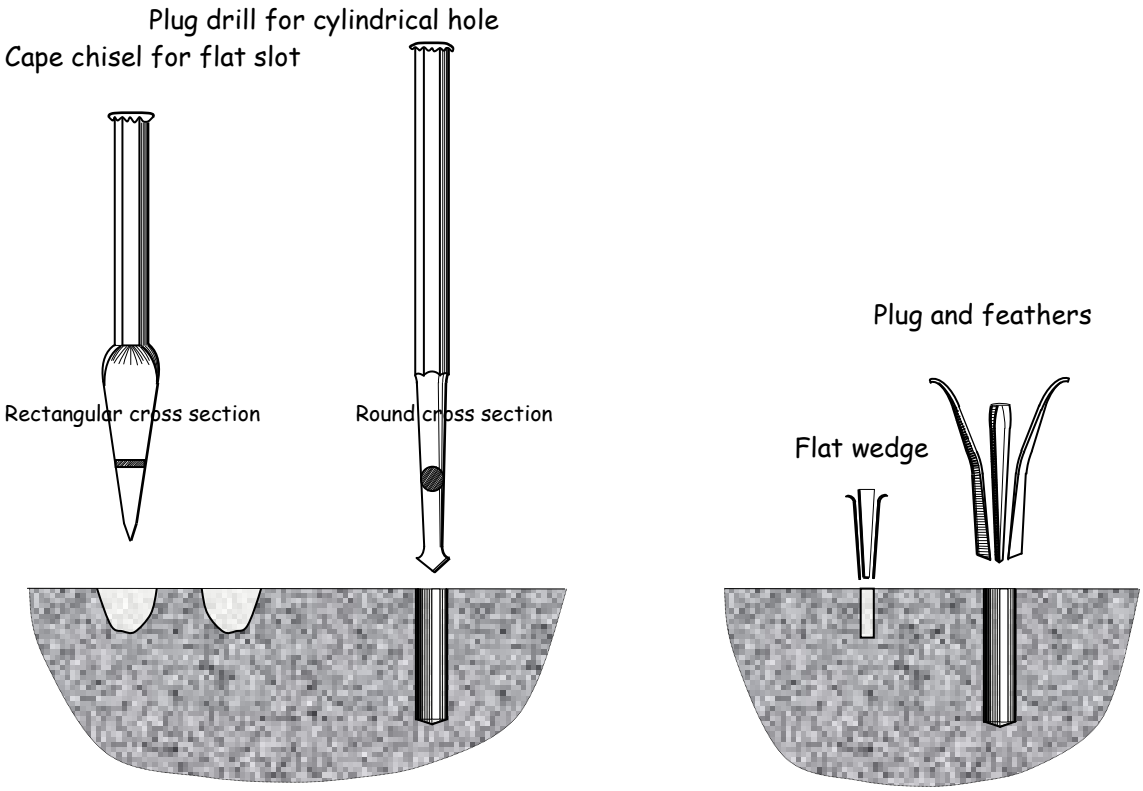
The roof frame of an addition of the early 1800s should be a rafter-and-purlin frame much like that of the older (southern) portion of the roof. Instead, the current roof frame is composed of pairs of common rafters. And these rafter pairs are highly unusual: the rafters on the rear (west) slope of the roof are hewn, while those on the eastern slope of the roof are sawn planks. It appears that the roof of the extension of the early 1800s was replaced in the mid-1800s, at the same time that other changes were carried out on the house as described below. There is no obvious reason for such an alteration to the roof.

Evidence seen elsewhere in the house points to a second, fairly extensive remodeling that can be dated between 1830 and 1850. Stylistic clues point toward the latter part of this date range.

Much of the house is underpinned with granite. The splitting marks visible on this stone show evidence of the use of the plug drill, which makes a round hole into which wedges and shims, called "plugs and feathers," were inserted to split the stone. Use of the plug drill and plugs and feathers was introduced around 1830, supplanting an earlier method that used a chisel to create a line of flat slots. Thus, the granite underpinning of the house appears to postdate the federal-style woodwork in the northern end of the building by some years.

The plug drill, which had a V-shaped point and was rotated slightly between each blow of the hammer, creating a round hole two or three inches deep. Into this hole were placed a pair of half-round steel shims or "feathers," and between these was driven a wedge or "plug" which exerted outward pressure and split the stone. The advantage of the "plug-and-feathers" method of splitting was the depth within the stone at which the wedges exerted their pressure, thus allowing larger pieces to be split more accurately.

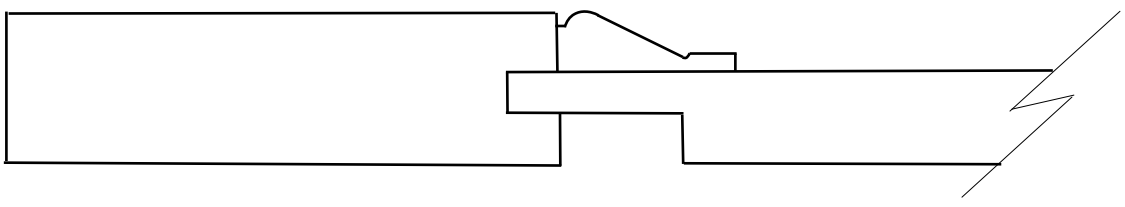
As shown below, the use of the plug drill and plugs-and-feathers creates a distinctive mark at the edges of the split stone, easily differentiated from the flat indentations made by the older method of chiseling a line of flat slots in the stone and inserting flat iron or steel wedges.



Similarly, the use of common rafters, as seen in the roof above the northern extension of the house, is not seen in southeastern or central New Hampshire until the 1830s. The present roof system therefore seems to have supplanted the roof of the early 1800s, but the reason for replacing the original early nineteenth century roof us unknown. As noted above, the present roof exhibits another anomaly in having one rafter in each pair hewn, with the accompanying rafter sawn.

Strong evidence for the investment of funds in the house is seen at the southern entrance to the building. The exterior design of this entrance is strongly Greek Revival in character. The design is characteristic of the period between 1830 and 1850.

On the interior, the doors that lead from the small stairhall of entry display a characteristic Greek Revival cross-section, as shown below.



Such doors as these derive from books like Asher Benjamin's *The Practical House Carpenter* (Boston, 1830) and later volumes that introduced and validated the Greek Revival style. Such details clearly establish a further remodeling of the Cartland House at some point between 1830 and 1850, the general date range of the Greek Revival style.

Further evidence of the possible date of these remodelings may be provided by the oven door that was installed on the northern chimney to supplant whatever door had existed there at the time that chimney was constructed. This cast iron door bears the words, IRON FOUNDRY SOUTH NEWMARKET, N. H. 1849. The foundry in South Newmarket (now Newfields) produced these doors in great numbers after 1849, and they are widely found throughout southern New Hampshire.

Since it is evident that the Cartland House was remodeled to some degree between 1830 and 1850 (and possibly in 1849, or shortly after, to judge by the oven door), it might be suggested that these changes corresponded to an altered use of the house. It is known that Moses Cartland returned from teaching in Providence, Rhode Island, in 1846 and founded Walnut Grove School in the former Friends' meeting house across the road in 1847. The main house, meanwhile, was occupied by Moses' brother Jonathan and by his sister Phoebe. Possibly students at the academy boarded in the Cartland House, and possibly the house was modernized for their accommodation.

These observations on the evolution of the house are incidental to an examination of the northern chimney. But the house exhibits its history in many ways, some of them not clearly understood, and each change to the dwelling was made with substantial investment and a clear intention of expressing the then-current style or using the then-current technology. The house represents a physical record of the Cartland family, as well as of later non-family owners. These notes are offered to assist those who are responsible for the house to understand its complex physical history, to be watchful for evidence or documentation concerning the changes that have occurred over the years, and to continue the excellent stewardship the house has received in recent decades.