HONEYMOON BRIDGE
(Jackson Bridge)
National Covered Bridges Recording Project
Spanning Ellis River at State Route 16A
Jackson
Carroll County
New Hampshire

HAER NH-41
NH-41

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001

HISTORIC AMERICAN ENGINEERING RECORD

HONEYMOON BRIDGE
(Jackson Bridge)
HAER No. NH-41

LOCATION:	Spanning Ellis River at State Route 16A, Jackson, Carroll County, New Hampshire UTM: 19.325127.4889903
DATE OF CONSTRUCTION:	Traditionally dated ca. 1876
FABRICATOR:	Attributed to Charles Austin Broughton
PRESENT OWNER:	State of New Hampshire
PRESENT USE:	Vehicular bridge
SIGNIFICANCE:	The Honeymoon Bridge is one of more than twenty surviving examples of the Paddleford truss, once a dominant covered bridge form in northern New England. This bridge is significant for its purported association with Charles Austin Broughton, who came from a three-generation bridge-building family of some regional importance.
HISTORIAN:	Dr. Mark M. Brown, August 2003
PROJECT INFORMATION:	The National Covered Bridges Recording Project is part of the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER is administered by the Historic American Buildings Survey/Historic American Engineering Record, a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration funded the project.

Description[1]

The Honeymoon Bridge is a fifteen panel, 119'-9" long (measured from center to center of the end posts), Paddleford truss covered bridge augmented with laminated arches. A 4'-10" wide cantilevered walkway is on the upstream side of the 15'-8-3/4" wide traffic lane.[2] Unfortunately, a 3'-2" high box encloses the bottom part of the truss and prevents measurement of the overall truss depth. The dry stone granite ashlar abutments are 104' apart as measured between the facewalls. Concrete pads and backwalls rest on the abutments and support bedding timbers (inaccessible) and the bottom chords.

In form, if not in structural behavior, a Paddleford truss is a multiple kingpost with counter braces that span about one-and-one-half panels. Fourteen of the Honeymoon Bridge's panels are 8' on center, while the fifteenth, easternmost, panel (excluding the partial panels of the overhanging portals) is 7'-9". Each kingpost, brace, and counter brace is 8-1/2" x 8-1/2", 5-3/8" x 8-1/2", and 3-5/8" x 6-5/8" respectively. The top chords are composed of four sticks. On the north truss the outer two sticks of the panel measured were 2-3/4" x 11-1/2". The inner sticks were 3" x 11-3/4" and 3-1/4" x 12".

Fully executed Paddleford trusses require elaborate and extensive joint framing. Indeed, the counter braces are pinned and framed into each member they cross: top and bottom chords, braces, and kingposts. In addition to treenails, a 3/4" diameter metal spike of unknown date further reinforces each connection. Two 3" x 4" angles, with signs of electric arc welding, currently serve as knee braces. They replaced wood knee braces that were mortised, about 1-3/4" x 5", and tenoned into the kingposts and the tie beams. The upper lateral bracing system is not safely accessible, but consists of tie beams and cross braces tightened with wedges.

The laminated arches consist of twelve leaves with overall dimensions of 8" x 24-1/2" bolted to the truss. Metal hanger rods (presumably 1930s vintage) suspend the deck beams from the arches and are 1" in diameter. They are so heavily rusted that they must be steel.

The deck system is inaccessible.

A substantial amount, perhaps a quarter to one third, of the original structure has been replaced or repaired. The entire deck system and bottom chords are replacements. The counter braces have been severed from the bottom chords. The four easternmost upper lateral bracing system panels are also newer.

History

The Ellis River drains the southeastern flank of the Presidential Range and joins the Saco River near Glen, New Hampshire. Near the village of Jackson, the East Branch of the Ellis River, also

[1] This report is based on field measurements made in August 2003 and on "Existing Truss Conditions" drawing, Clough, Harbour & Associates LLP, August 28, 2002, in DOT Project files, Jackson, 2002, Honeymoon Bridge (148/050) Project No. 13735, New Hampshire Department of Historic Resources, Concord, New Hampshire.

[2] According to covered bridge historian Joseph Conwill, "The persistent rumor that the bridge was at some point 'widened' may refer simply to the addition of the sidewalk."

known as the Wildcat River, hastens the Ellis on its journey. Even as late as 1894, about one-half of the Town of Jackson was virgin forest.[3] During the nineteenth century, the combination of the mountains, the forest and its hunting potential, and the Wildcat River's picturesque Jackson Falls offered escape and relief for an increasingly industrialized northeast. The first purpose-built hotel in Jackson opened in 1858.[4]

Despite its increasing prosperity, the town records are not entirely clear when the Ellis River was first crossed or even when the current covered bridge was built. The crossing is of some antiquity, but probably dates to some time after the town's incorporation in 1800 because there was access to the village from the southeast that did not require crossing the Ellis.[5]

The data and construction history of the bridge is unclear. Noted bridge historian Richard Sanders Allen attributes the bridge to Charles Austin Broughton and dated it ca. 1876 (revised to 1876).[6] In an unpublished collection of interviews and memoirs, long-time Jackson resident Adelbert Fernald reports that the bridge was "constructed about the time the Maine Central Railroad was run through Crawford Notch by their engineer in 1870."[7] Broughton's descendents, however, firmly assert that he never worked for the Maine Central, but was a finish carpenter and a lumber company agent who built bridges "on the side."[8] In October 1873 town residents discussed whether to build and/or repair at least two bridges, although the new bridge was clearly across the Wildcat and not the Ellis. Three years later, the town continued discussing the idea of a new bridge across the Wildcat. These discussions make it clear that the town's clerk(s) recorded bridge discussions in the mid 1870s. Further research in the town records may help clarify the uncertainty surrounding the 1876 date.[9]

The post construction history of the bridge is a little clearer. In 1899, the town paid $8 dollars to the Goodrich Falls Electric Company for "light in bridge" -- a turn of phrase that suggests a bridge with an "inside."[10] While it is not clear when the covered bridge became part of the state

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[3] New Hampshire Forestry Commission, *Map Showing the Relative Area and Character of the Forest Cover of Carroll County, N.H.,* 1894, in New Hampshire Historical Society, Concord, New Hampshire, Special Collections, Drawer 17, Carroll County.

[4] Bryant F. Tolles, Jr. *The Grand Resort Hotels of the White Mountains* (Boston: David R. Godine, 1998), 77, 63.

[5] Robert and Mary Hixon, *The Place Names of the White Mountains: History and Origins* (Camden, Maine: Down East Books: 1980), 91; Alice Pepper, Jackson Historical Society, in telephone conversation with author, August 18, 2003.

[6] Richard Sanders Allen, *Covered Bridges of the Northeast* (Brattleboro, Vermont: and Stephen Greene Press, 1957), 108; Richard Sanders Allen, *Covered Bridges of the Northeast*, revised edition (Brattleboro, Vermont: Stephen Greene Press, 1974), 107.

[7] Adelbert Fernald, *Early Historical Facts of Jackson, N.H. and its Centennial, July 4, 1878*, n.p., copy of scrapbook in Jackson Public Library, Jackson, New Hampshire.

[8] Margaret B. Garland, Historian, Jackson Historical Society, to Richard G. Marshall, April 3, 1991, in Covered Bridge file, Town Offices, Town of Jackson, New Hampshire; Kathy Menici, Great-Great Granddaughter of Charles Austin Broughton, personal conversation with author, July 30, 2003. Menici, who is writing a National Register of Historic Places Nomination for the Jackson Bridge, also reports the family tradition that Broughton built seven bridges. Of these, only Jackson and the spectacular 224' double span Saco River Bridge in Conway Village, Conway, New Hampshire, remain.

[9] Town of Jackson, *Minutes*, Book No. 6, October 4, 1873, pp. 288-289 and November 7, 1876, p. 343, in Town Records Vault, Jackson Grammar School, Jackson, New Hampshire.

[10] Town of Jackson, *Town Reports*, February 15, 1900, p. 9. Hereinafter cited as *Town Reports.*

highway system, Route 16, of which the bridge is a spur, became part of the state system about 1913.[11] The sidewalk was added to the bridge in 1930.[12] There are vague suggestions that the bridge was widened at some point, but the seemingly intact upper lateral bracing system and the absence of evidence that the granite abutments were widened reinforces the view that it was not.[13] The date of the arches is unknown.

Joseph Conwill has suggested that the name "Honeymoon Bridge" could have its origins in a 1936 essay written by early bridge historian Adelbert M. Jakeman.[14] Jakeman described fond memories of time spent on the bridge with his wife during their honeymoon. “It might well be named Honeymoon Bridge,” he wrote. To date, no earlier reference to the bridge as the “Honeymoon Bridge” has surfaced.[15]

The bridge, a regular stop for bus tours, is often described as one of the most photographed covered bridges in New Hampshire. It is scheduled for a major rehabilitation in the near future.

Peter Paddleford and the Paddleford Truss

Peter Paddleford (1785-1859; active 1820-1850) was a millwright and bridge builder in northern New England who developed his non-patented Paddleford truss design after experience building Long and Pratt trusses.[16] While little is known about his life and career, Joseph Conwill has observed that his truss "became the dominant type in covered bridge construction over a wide area extending from Orleans County, Vermont, eastward across northern New Hampshire, and on through Oxford County, Maine." The reason for this broad distribution is probably due more to local builders copying, or trying to copy, Paddleford's design, than to the work of Paddleford or his son Philip.[17]

As mentioned above, the Paddleford truss has the appearance of a multiple kingpost truss reinforced with distinctive counter braces. In trying to understand Paddleford's conception of his design's structural behavior and in trying to understand how it actually behaves, it is useful to consider another possibility. Paddleford could have conceived of his design as a non-prestressed variant of a Long or a Howe truss. The counter braces become eccentrically placed diagonals

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[11] Joyce B. McKay, Cultural Resource Manager, Bureau of Environment, New Hampshire Department of Transportation, telephone conversation with author, July 20, 2003.
[12] *Town Reports*, January 31, 1930, p. 3.
[13] Garland to Marshall, 1991.
[14] Adelbert M. Jakeman, *Old Covered Bridges: The Story of Covered Bridges in General* (Brattleboro, Vermont: Stephen Daye Press, 1935).
[15] [Joseph Conwill], "History Doubles Back?" *Covered Bridge Topics* (Spring 1993): 3. Jakeman's essay appeared in the April 1936 issue of *The New Hampshire Troubadour*.
[16] According to covered bridge historian Joseph Conwill, “Paddleford was one of the most important bridge builders and mill wrights in northern New England during the 1830-1850 period. But surely he was <u>active</u> well before he was <u>important</u>. He moved to Littleton in 1830 and we do not know what he was doing in the 1820s. However, he was invited to Montreal in 1833 to give an estimate for a huge and expensive project, and it is not likely that a neophyte builder would have inspired such confidence.”
[17] This paragraph is based on Joseph Conwill, “Sunday River Bridge,” HAER No. ME-69, Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, 8.

from this perspective.[18]

In examining each of these possibilities, it is important to keep in mind the redundancy of the design, the nature of the connections, and how the top and bottom chords carry forces in the counter braces. A typical Paddleford truss is highly indeterminate. It has many more members and connections than needed for stability and consequently there are many load paths. The configuration of the connections between the counter braces and the other truss members makes it clear that Paddleford envisioned a tension member. That is, if Paddleford expected compression in the counter braces, he would have used the type of butt connection found between the braces and the kingposts -- what Dario Gasparini has termed "non-positive."[19] Finally, it is important to realize that any vertical forces transmitted between the chords and the counter braces involve the bending strength of the chords. Applying the method of joints to the chord-counter brace panel-points makes this clearer. Static equilibrium requires a mechanism to resist the vertical components of the forces in the counter braces. Since the connections lack another member to do this, bending in the horizontal chords must resist the vertical forces. Depending on the placement of the deck beams, the bottom chord might transfer a significant amount of bending moment to the counter braces. University of Vermont engineering professor Jean-Guy Béliveau, however, has suggested that the counter braces would not impose much bending moment on the top chords.[20]

Long/Howe

Given his documented experience building Long trusses, Paddleford may have sought to improve on certain deficiencies he observed -- an impulse not unlike the one that motivated Howe and Stone in their development of the Howe truss.[21] Long's truss employs wedges to impose sufficient prestress on the diagonals so that they remain in compression for any live loadings. Certain load placements put tensile loads on some of the diagonals, but proper prestressing generates enough compression that the net force will still be compression. This condition permits the use of simpler, non-positive, connections for all diagonals. Paddleford's experience with Long trusses would make him familiar with these concepts, but he chose not to employ them on his trusses. (The reader will remember, however, that the upper lateral bracing uses wedges.) Surely Paddleford realized that a structural member placed in the general area of his counter braces would take tensile forces. The question might then be, what were his options in adding a tensile member to a multiple kingpost truss? Whatever he might have chosen, he could not reduce the critical section at the connection between the post and the chords because to do so would weaken a tensile member. If Paddleford conceived of his truss as a non-prestressed improvement on Long's work, then the eccentrically placed counter brace was one way to do it.

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[18] This section is based on conversations with Jean-Guy Béliveau, PE, PhD and Chair, Department of Civil and Environmental Engineering, University of Vermont, July 24, 2003; Justin M. Spivey, Consulting Engineer, Robert Silman Associates, New York, electronic communications with author, August 7 and 22, 2003; and Prof. John Ochsendorf, Massachusetts Institute of Technology, telephone conversation with author, August 8, 2003.
[19] Dario Gasparini, and David Simmons, "American Truss Bridge Connections in the 19th-century. I: 1829-1850," *Journal of Performance of Constructed Facilities* 11, no. 3 (August 1997): 121-122.
[20] Béliveau, personal conversations with author, July 24, 2003.
[21] Gasparini and Simmons, "American Truss Bridge Connections," 121-123.

Another factor that Paddleford might have considered, whether he conceived of his design as a Long or a multiple kingpost, is the dimensional instability of wood. Timber framers require wood that is green enough to work easily. As wood dries and hardens, however, it shrinks. On the other hand, wood is also subject to creep under prolonged loading. Creep shortens compression members and elongates tensile members. Together, shrinkage and creep can loosen critical connections. Thus both Justin M. Spivey and John Ochsendorf raise the possibility that Paddleford might have seen his counter braces as a means to restrain the members and compensate for these dimension changes.[22] Unlike, the Long and Howe trusses, Paddleford's arrangement would not require post-construction adjustments. Spivey observes:

> Whereas a Long truss has (and needs) prestressing wedges to keep the compression counterbraces active, the Paddleford truss has tension counter braces that are always active, no matter how much creep deformation occurs, until failure occurs. The Paddleford truss form is more intriguing because the counterbraces and primary diagonals are connected to each other and restrain each other's creep deformations. Could the "primary" diagonals lose contact with the vertical post shoulders and the counter braces start carrying dead load? Or do the multiple connections between web members work to prevent this somehow? A surprisingly complex analysis would be required to obtain satisfactory answers to these questions.[23]

The alternate view, that Paddleford conceived of his design as an improvement to the multiple kingpost truss, is much simpler and more direct. Paddleford may have been seeking to strengthen a successful design by adding additional load carrying capacity. Perhaps he added the counter braces to reduce bending of the bottoms chords due to deck beam loads. In this case, any connection restraint was an added bonus. Tom Peters has observed that the overlaying of familiar truss types in order to create longer and stronger bridges was common in at least the eighteenth and nineteenth centuries.[24] If so, then Paddleford is not working within the emerging academic tradition as much as within the craft tradition. Certainly, his connections require much more framing skill than the more scientifically based Howe truss.

In conclusion, while the Honeymoon Bridge preserves a moderate amount of the Paddleford truss's distinctive design features, there is enough to recognize the skill required of Charles Broughton and other builders and to raise provocative questions about the structural behavior of the form.

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[22] Spivey, electronic communications with author, August 7 and 22, 2003; Ochsendorf, telephone conversation with author, August 8, 2003.
[23] Spivey, electronic communications with author, August 7 and 22, 2003.
[24] Tom F. Peters, "Bridge Technology and Historical Scholarship," *Proceedings of the First International Congress on Construction History*, ed. Santiago Huerta (Madrid: Instituto Juan de Herrera, 2003), vol. 1, 62-64.

Bibliography

Allen, Richard Sanders. *Covered Bridges of the Northeast*. Brattleboro, Vermont: and Stephen Greene Press, 1957.

_____. *Covered Bridges of the Northeast*, revised edition. Brattleboro, Vermont: Stephen Greene Press, 1974.

Béliveau, Jean-Guy, Chair, Department of Civil and Environmental Engineering, University of Vermont. Personal conversation with author, July 24, 2003.

Conwill, Joseph. "History Doubles Back?" *Covered Bridge Topics* (Spring 1993): 3.

______. "Sunday River Bridge." HAER No. ME-69. Historic American Engineering Record, National Park Service, U.S. Department of the Interior.

Fernald, Adelbert. *Early Historical Facts of Jackson, N.H. and its Centennial, July 4, 1878*, copy of scrapbook in Jackson Public Library, Jackson, New Hampshire, n.p.

Garland, Margaret B. Historian, Jackson Historical Society, to Richard G. Marshall, April 3, 1991, in Covered Bridge file, Town Offices, Town of Jackson, NH.

Gasparini, Dario and David Simmons. "American Truss Bridge Connections in the 19th-century. I: 1829-1850." *Journal of Performance of Constructed Facilities* 11, no. 3 (August 1997): 119-29.

Hixon, Robert and Mary. *The Place Names of the White Mountains: History and Origins.* Camden, Maine: Down East Books: 1980.

Jakeman, Adelbert M. *Old Covered Bridges: The Story of Covered Bridges in General.* Brattleboro, Vermont: Stephen Daye Press, 1935.

McKay, Joyce B., Cultural Resource Manager, Bureau of Environment, New Hampshire Department of Transportation. Telephone conversation with author, July 20, 2003.

New Hampshire Forestry Commission. *Map Showing the Relative Area and Character of the Forest Cover of Carroll County, N.H.,* 1894, in New Hampshire Historical Society, Special Collections, Drawer 17, Carroll County.

Menici, Kathy, Great-Great Granddaughter of Charles Austin Broughton. Personal conversation with author, July 30, 2003.

Ochsendorf, John, Massachusetts Institute of Technology. Telephone conversation with author, August 8, 2003.

Pepper, Alice, Jackson Historical Society. Telephone conversation with author, August 18, 2003.

Peters, Tom F. "Bridge Technology and Historical Scholarship," in *Proceedings of the First International Congress on Construction History*, ed. Santiago Huerta, vol. 1, 60-67, Madrid: Instituto Juan de Herrera, 2003.

Spivey, Justin M., Consulting Engineer, Robert Silman Associates, New York. Electronic communications with author, August 7 and 22, 2003.

Tolles, Bryant F. Jr. *The Grand Resort Hotels of the White Mountains.* Boston: David R. Godine, 1998.

Town of Jackson, New Hampshire. *Minutes*, in Town Records Vault, Jackson Grammar School, Jackson, New Hampshire.

_____. *Town Reports*, in Town Records Vault, Jackson Grammar School, Jackson, New Hampshire.