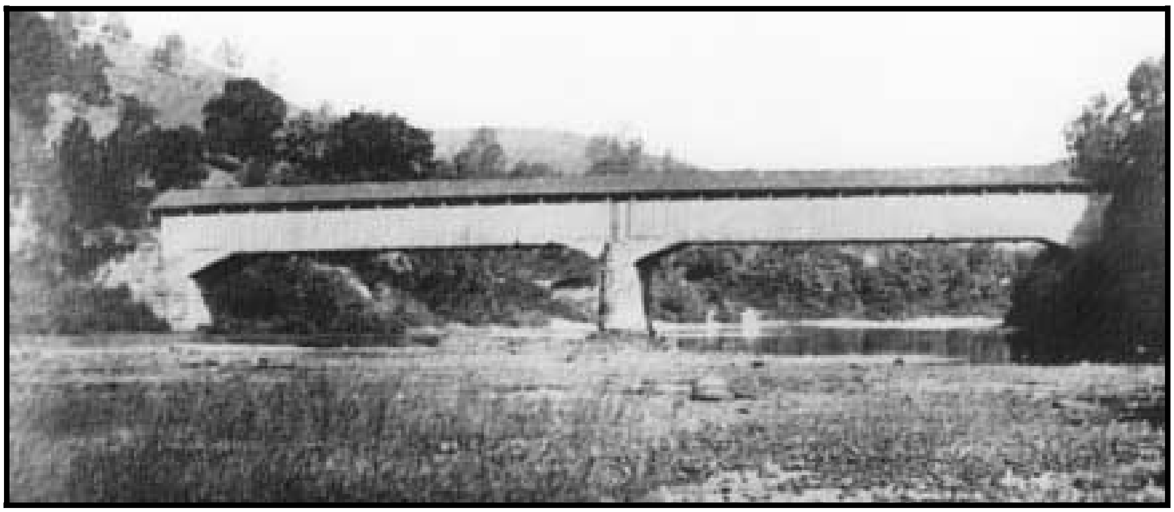
APPALACHIAN BLACKSMITHS ASSOCIATION

Covered Bridge Turns 150

but not without some scary days!



The Philippi Covered Bridge—site of the first land battle of the Civil War

In 1851/52, a young blacksmith named Amasa Kittle made bolts and nuts for the new covered bridge spanning Tygart's River. His products were but a token towards the total project. The six graceful 140' arches, hewn from yellow poplar, required most of the metal fasteners—they were built in segments. The Burr truss beams were notched, mortised, tenoned, and pinned with wood plugs or wedges.

Kittle's wrought iron was probably manufactured at nearby Valley Furnace where iron production of 4.5 tons per day began in 1848. The iron was hauled by wagon to Fairmont and then barged to Wheeling. Kittle may have used finished iron shipped on the return trip.

Originally a toll bridge on the Beverly-Fairmont Turnpike, the Philippi Bridge has since carried the traffic of US250, making it the only covered bridge in America on the US primary highway system.

The bridge also holds a special place in history. Union and Confederate troops battled here on June 3rd, 1861. This is the site of the first land battle of the Civil War.

Note: West Virginia did not become a state until June 20, 1863. Thus, the bridge was built when the area was still part of Virginia.

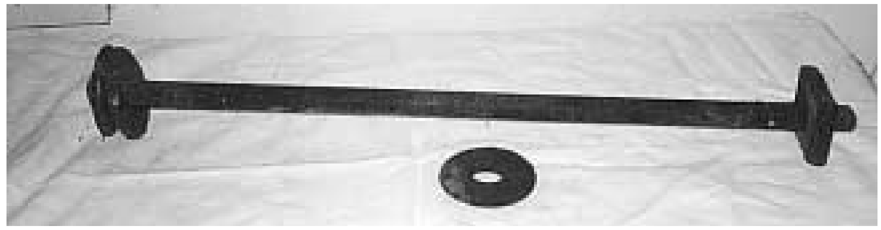
THE BUILDER

Lemuel Chenoweth of Beverly responded to an 1850 advertisement for bids to build a new bridge at Philippi. Already an accomplished bridge builder, he made an exact scale model of his design. He tied the model to his saddle and rode over the mountains to Richmond, hopeful of winning the contract.

Although other engineers scoffed at him and his crude wood model, Chenoweth had the last laugh. To demonstrate the strength of his design, he placed the model between two chairs and then stood on it. The model did not so much as bend under his weight, prompting one official to quickly calculate that the actual bridge would support a man some 600' tall! Chenoweth won the contract, the final cost of the bridge being $12,181.24. That's $40 per linear foot if you are counting.

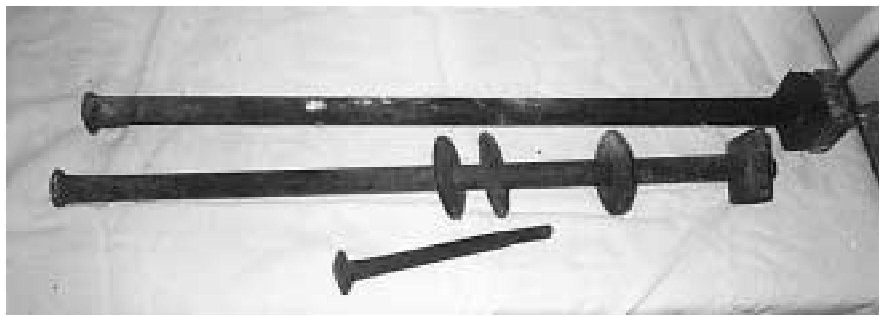
Prior to designing the Philippi Bridge, Chenoweth learned his formal math and engineering skills from Col. Claudius Crozet, a French military engineer who first taught at West Point and then was appointed head of Virginia's public works projects. Crozet designed and supervised the building of the Staunton-Parkersburg Turnpike, which passed through Beverly, and that is how the two men met.

The section of the turnpike that ascends Rich Mountain from Beverly is still renowned by engineers for its constant gradient. This turnpike connected other Virginia turnpikes as well as the port at Norfolk to the Ohio River, all in all an important road through the Appalachians.



Original wrought iron bolts from the Philippi Covered Bridge.

Top: 26" x 15/16" arch bolt with cast iron donut head washer, square flat washers, and square nut
Bottom: 26" x 15/16" arch bolt; 21-1/4" x 13/16" top beam bolt with donut washer, flat washers and nut; 7-3/4" x 1/2" top brace bolt



Photos courtesy of Eugene Ratliff, restoration blacksmith

THE SITE

Chenoweth selected the narrowest crossing site possible that also required the least amount of excavation to bedrock. The riverbed is solid and very shallow here.

He would have used 5, and as many as 10, slip scrapers to excavate loose dirt and gravel from the abutment and center pier foundation sites. The scrapers piled the dirt around the foundations to make small cofferdams, keeping water at bay. The scrapers also built a causeway from one shore to the center pier, using as much dirt and rock as they could from the riverbed.

A horse could pull a slip scraper for about an hour before needing rest. The work was rugged, meaning that shoes needed frequent attention. Chenoweth would have needed two or three horses per scraper while excavating the site and building the cofferdams and roads.

THE TIMBER

All of the structural timber is yellow Poplar. In 1851, Chenoweth found a nearby grove of Poplar with trees as large as 60" in diameter. "Tulip" Poplar is light, clear-grained, very strong for its weight, and insect resistant if kept dry.

I could find no reference for a water-powered sawmill but Philippi did have a gristmill at the time. Given that Philippi was the county seat with a courthouse, retail center and innumerable houses, there probably was a local water-powered mill with a reciprocating saw. The board siding and deck planks were cut from yellow Poplar.

Froes were used to split the approximate 20,000 roof shingles—most likely split from Chestnut Oak or American Chestnut. In this era, shingles were of irregular width but would have averaged 6" wide and 18"-24" long. The shingles overlapped so that only the bottom third or fourth of each shingle was exposed.

The very large logs were halved and then quartered with a 2-man saw. This made them easier to drag. Also, quarter-sawn lumber is preferred for strength because the grain runs nearly perpendicular to the plane of the board.

THE FOUNDATIONS

The crews used pry bars and picks to remove loose rock from the bedrock seam that is the foundation. They would have been as finicky as dentists in this regard because of the tremendous weight of the stone abutments and center pier.

Nearby sandstone was quarried and hauled on sleds to the site. There is an old quarry site up the hill from the bridge on the west side

Feb, 2, 1989—Gasoline leaking from a tanker at a nearby gas station flowed into the bridge and ignited. The beam hanging above the vehicle is a steel beam. All of the siding and roof burned but most of the truss members and the arches were spared serious damage.

The flood of Nov. 1985 wiped out over 30 bridges including both spans of the massive iron trestle on the B&O RR main line at Rowlesburg on the Cheat River. That the Covered Bridge suffered only minor damage, mainly the loss of siding boards on the downstream side, is a testament to its structural strength. The covered bridge was back in use as soon as the floodwaters receded.

CALAMITIES

1850—Typhoid Fever epidemic decimates O'Brien's crew (17 dead). Bridge delayed for one year.
1861-65—During Civil War, bridge is almost burned (two occasions).
Ice jams and/or floods posed threats in every decade.
1934—young boy falls through wood bridge deck to his death.

of the river. The large, rectangular rocks were lifted in place and then grouted with cement mortar.

As successive lifts in the abutments went up, the slip scrapers would start backfilling with dirt. The compacted backfill would have kept up with the top 2-3 courses of stone.

It is here that Chenoweth would have been using 10 or more slip scrapers because the roadway approaches had to be built concurrently with the backfill operation.

NAILS

Upon completion of the structural truss framing, one workman said, "There's not a nail in her!" As mentioned, the structure of the bridge has few metal fasteners.

There were, obviously, kegs and kegs of nails in the bridge's "skin". I could not learn where the nails were made but am sure that they were headed, cut nails rather than hand-forged. Cut nails were being mass-produced by 1820. By the 1840's, Wheeling had already earned its nickname of "Nail City" so it is quite possible that the nails came from there.

HORSE TEAMS

Trying to determine how many horses were used on the project is just about impossible in this day and age. Consider this: The 1850's workman worked 10 hours per day, six days per week. Most horses were rented from area farmers who, no doubt, needed their horses during plowing and harvest seasons.

On rainy days, or days that the river was up, the horses that normally pulled scrapers would have been used to drag logs to the mill or to the site. Or they might have sledded stones from the quarry to staging areas. And they also teamed to pull freight wagons loaded with boards.

The economics of the job dictated using as few as horses as possible. We can assume that 20 horses were there most of the time with perhaps 40 at peak schedule.

With this many horses, there had to be a full-time blacksmith/farrier who also did harness work. And he probably hired 2-3 boys as helpers. One of these lads probably peddled away at night sharpening axes and tools on the grinding wheel.

TOOLS & EQUIPMENT

Before the bridge went up, Philippi had its local smithy. As this was Chenoweth's 12th bridge job, one may assume that he already had a lot of tools and just needed to gear up for this, his biggest project.

Bridge construction and future prospects of increased traffic and commerce on the turnpike probably caused another smithy or wagon shop to start in business. These shops, plus the others in the Valley, no doubt provided tools, hardware, and equipment for the job as well as made necessary repairs.

The year 1850 can be considered a watershed year. That year, the Valley Furnace ironworks imported a steam engine, the first in the county, to run the furnace's air blower and trip hammer. The B&O railroad was the first to cross the mountains, reaching Grafton, some 20 miles downstream of Philippi, in Jan. 1852. The B&O reached Fairmont in July, about the same time that the bridge was completed. Rail service to Philippi, however, came much later in the century. Thus, we can assume that Philippi was still fairly remote in 1850-52 and that the tools used to build the bridge were made locally.

And just think of the hand tools needed to build this bridge.

Start with the logging crews who needed axes, saws, cant hooks, wedges, chains and hooks. The wood wrights needed axes, adzes, and other hewing tools to fashion the beams. The carpenters needed sledges, hammers, chisels, gouges, and augers to shape and join the beams. The roofers needed froes and hammers. And the masons needed a wide variety of quarry and masonry tools plus the equipment to lift the rocks into place. Perhaps, only the engineering tools like the transit, level, and measuring chain were manufactured in the eastern cities.

As predicted in 1850, this bridge ultimately did carry live loads of 10 tons (the 600' man would have weighed 20,000 lbs.) before the wood deck was removed and replaced with a concrete deck.

RESTORATION

After the 1989 fire, historians soon learned that the bridge had been modified many times. The concrete deck, pedestrian walkway, board & batten siding—all were changes from the original bridge. The restoration team spent months just collecting facts, including the original plans and contract at the Virginia archives in Richmond.

Certain modernizations, such as a fire suppression system, were included in the project to prevent a future catastrophe. The actual modernization and restoration work took about a year to complete and cost $2 million.

THE RESTORATION BLACKSMITH

Eugene Ratliff, an Oak Hill blacksmith, was hired to reproduce and repair the bolts that Amasa Kittle made some 137 years prior. The arch segment bolts were 15/16" diameter with round heads. While the fire damaged some of these bolts, most had their thread ends ruined when the crew removed them by driving them out with a sledge.

Unable to locate wrought iron, Eugene used 1" mild steel to reproduce 109 bolts and reworked 38 originals. By upsetting the 1" rod in the ladle mold of his swage block, he perfectly duplicated the round head and tapered shaft of the original bolts. The top chord and top beam bolts were headed in the same manner but reproductions were made from 7/8" mild steel.

The top braces were originally fastened with 1/2" square shank bolts with round thread ends. All of these bolts broke during removal and were reproduced.

Eugene noted that the round bolt heads had their purpose. As livestock frequently crossed the bridge, the round heads prevent an animal from being cut should it stray into a beam or arch.

To make the round head hold, a cast iron donut washer was used. These washers had a tapered hole to sleeve the tapered bolt shaft.

The arch bolts used 3/4" thick donuts and the beam bolts used 1/2" thick donuts. All of the donuts were saved and reused.

Eugene made 2" x 10" mortise chisels for the woodwright crew. He also made bar strap braces from 1/2" x 3" and 1/2" x 2" mild steel. And he made the "1991" touchmark with which the crew used to identify all of the replacement wood beams.

Eugene Ratliff touchmarked the new, replacement bolts to prevent any future misidentification.

AN INTERESTING OBSERVATION:

Mr. Chenoweth either goofed and ran short on wrought iron rod or else he needed extra bolts because several of the large bolts had been "stretched" by drawing them out in their centers. Other bolts were pieced by welding.

Was this another case of a contractor who skimped on materials? Or just a smart blacksmith knowing where & how to cut corners?

It matters not. The bridge is so strong that the bolts are incidental to its overall strength.

Just ask the 600' tall man!

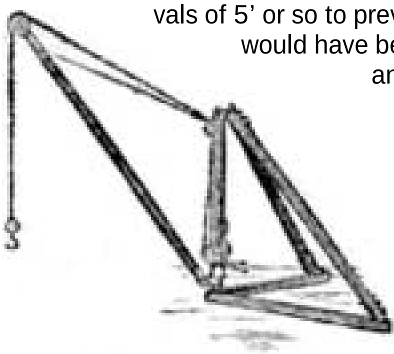
The Philippi Covered Bridge was completed in 1852 to a design by West Virginia's pioneer covered bridge builder, Lemuel Chenoweth. The bridge is an outstanding example of a modified Burr truss with two spans totaling 308 LF. It is historically significant in its own right as one of the finest examples of the timber bridge builder's art. In the mind of the public, however, it is identified with the first engagement of the Civil War following the shelling of Fort Sumpter.

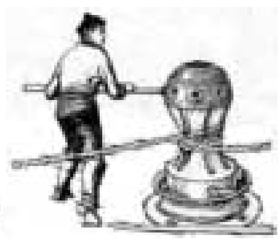
Emory L. Kemp, Director, IHTIA at WVU

How'd they do that?

Chenoweth would have used derricks made from logs, probably Ash, to lift foundation stones and the large arch sections. Most of the derrick's hardware, rigging, pulleys, chains and hooks were likely custom-made by local blacksmiths or at the project site.

The head and hook blocks would have had 3-4 sheaves each allowing for a multi-part hoist line. These blocks and all of the rope likely were purchased from the Baltimore shipyards. The derrick's boom would have been banded at intervals of 5' or so to prevent splitting. The boom would have been 8"-12" in diameter and 30'-50' long. The mast would have been half that length and may have been guyed by ropes rather than log spars.





The most intricate hardware on the derrick was the swing-swivel at the base of the boom that allowed for the boom to raise or lower and swing to the left or right.

Derricks are easily moveable. They would have been setup in the riverbed or on the causeway, positioned so they could "pick" anywhere along the length of the span.

The heavy foundation stones were lifted into place with pairs of grabs (compression tongs) rather than bound with chains. One worker, Mr. N. Poling, wrote in a letter that he and another man operated a capstan (winch) to hoist the stones and heavy wood beams. The derrick and capstan were old technology, having been used on ships for centuries.

The bridge superstructure was "launched" on a crude trestle which supported the span until all of the beams were joined. The trestle was then removed.

Derricks were used to erect the Empire State Building (1931). The derricks "jumped" from floor to floor as the building went up.

Quarter sawn lumber yielded a nearly perpendicular grain pattern

Chenoweth hired Emmett O'Brien, a skilled stonemason, to build the abutments and center pier for the bridge. Three prominent sandstone veins outcrop in the immediate area and were quarried for architectural stone in that era. O'Brien would not have been new to this task and probably supported himself handily as a mason.

To "cut" the stones, O'Brien would first drag a maul or similar tool across the rock while strikers with sledges tapped the maul. After establishing a groove for the fracture line, the strikers would hit the maul harder and harder. Surprisingly, these sandstones split cleanly with less effort than you might think.

Stones were typically cut on a 2' x 2' x 4' pattern and would weigh about 1.33 tons. Smaller stones of similar ratio are also evident in the foundations of the structure.

A skilled mason like O'Brien could "read the grain" of the sandstone and would cut accordingly. Thus, the stones were not identical like brick.

The stones were laid in place on shims, usually wood but sometimes iron. The stones are too heavy to lay on a bed of mortar. Once the stones were leveled and plumbed, the masons would grout the joints with mortar, mixing clean river sand with cement. Cement was made by burning coal, limestone, and clay in a kiln. (*It's still made that way.*) All three ingredients are available in the area.

A blacksmith would have supplied the O'Brien crew with sledges, mauls, wedges, and pry bars up to 6' long, for the quarry work. He also made shovels and hoes to mix the mortar, and trowels to place the grout. He also may have made drill rods with chisel bits for the stone cutting operation.

Once cut, the heavy stones were rolled onto horse-drawn sleds for transport to the jobsite. The wood runners of the sled were banded with iron to reduce drag.

Along with this assortment, O'Brien would have needed several chains and the large grab tongs used to lift the stones into place.

How do you split 20,000 shingles? One at a time!

After the shingles were split with a froe, they were stored in the river to keep them "green" until nailed in place.

The Slip Scraper (also "scoop shovel") was the prime earthmover in olden times.

The scraper was pulled by one horse and the operator, a "teamster", used the dual handlebars to set the scoop to dig, slide (travel), or to dump. The scraper held about 1/8 cubic yard of soil. The loaded scrapers, along with the horses, also compacted dirt as they traveled over the fill area.

Slip scrapers were used well into the 1930's to build projects such as flood dikes and levees for the Tenn. Valley Authority.

Sources

- *Grafton native Jack Lanford, Engineer/Bridge Contractor (Lanford Brothers Co., Inc.), contributed to this article. He is a former Chairman of the American Road and Transportation Builders Association*
- *Mr. Norm Roush, PE, Deputy Commissioner, WV Division Of Highways, Charleston, WV*
- *Barbour County Museum, 200 N. Main Street, Philippi WV 26416*
- *Institute for the History of Technology and Industrial Archaeology, Emory L. Kemp, Director. West Virginia University*
- *"Milestones: A Pictorial History of Philippi, WV" by Jane K. Mattaliano, reprint brochure edition*
- *1850 Census: Amasa Kittle is 28 years old.*
- *WV Division Of Culture & History; "The Beginning", Ruth Woods Dayton, Vol. 13, No. 4, pp 254-266*
- *WV Geological Survey, Barbour & Upshur Co's., 1918*
- *Interviews with Eugene Ratliff (blacksmith) and Blair Lee (foreman) for the restoration project.*
- *Bridge Photos reproduced from "Milestones" (reprint brochure edition)*
- *Clipart sources:*

Maul, sledge	www.somervillelumberco.com
Derrick, capstan	www.probertencyclopaedia.com
Quarter sawn	www.frankmiller.com
Froe	www.furnacecreekforge.com
Scraper	www.shelbycountyhistory.org

Replacement bolt inventory

Top chord bolts:

Length	14 1/4"
Diameter	13/16"
Nut	2 x 2 1/4 x 1/2
Total	105

Arch bolts (38 reworked)

Length	26"
Diameter	15/16"
Nut	2 x 2 1/4 x 3/4
Total	109

Top beam (framing) bolt

Length	21 1/4"
Diameter	13/16"
Nut	2 x 2 1/4 x 1/2
Total	95

Top brace bolt (60)

Length	7 3/4"
Head	1 1/4 x 1 1/4
Diameter	1/2" square
Nut	1 x 1 x 1/4

Submitted by Eugene Ratliff

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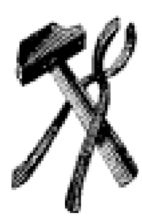

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