Leffert Lefferts Buck

By Frank Griggs, Jr., Ph.D., P.E., P.L.S.

Leffert Lefferts Buck at age 50.

Leffert L. Buck was born February 5, 1837 in Canton, NY into a family with a military tradition and an appreciation of the value of education. After attending the local academy, however, he chose to spend the next several years learning the machinist trade. At the end of that period, he enrolled in the first class at St. Lawrence University. After only two years of study, the Civil War broke out and Buck left college before receiving a degree.

Buck enlisted as a private in the Sixtieth (60th) New York Infantry in October 1861, six months after the war began. The 60th took part in the Battle of Antietam, where Buck was wounded in both legs. His regiment was later one of the last regiments off the field in the losing battle at Chancellorsville. He was stationed at Culp's Hill on the right flank of the Federals at Gettysburg, and fought off a major charge on the second day. The regimental history stated that in this four-hour period "great coolness was displayed by both officers and men." They were then sent to help lift the siege at Chattanooga, Tennessee, and were one of the main regiments that assaulted Lookout Mountain in the famous *Battle Above the Clouds* on November 24, 1863. The Regimental History stated that after the Color Sergeant was killed, "Sergeant Buck sprang forward, seized the flag, and, with a coolness and bravery undisturbed by the whiz of bullets, which came thick and fast, steadily bore it in advance of the regiment, and planted it, at last, on that point of the mountain where the rebels had boasted that the stars and stripes should never wave again. A brave and noble thing for you, Leffert!" In the following spring, the 60th was part of General William T. Sherman's Army that captured Atlanta after turning back General John B. Hood's attack at Peachtree Creek. Later in the fall of 1864, Sherman selected his very best men to make the march to the sea and Savannah, taking it just before Christmas of 1864. Sherman with Buck, now a Captain, started north January 27 and marched into South Carolina to the capitol of Columbia and thence, after Lee surrendered, to Washington. The 60th was mustered out of service July 17, 1865 and Buck enrolled at Rensselaer Polytechnic Institute in Troy, NY to study civil engineering.

In June, the class of 1868 read their theses and twenty-two men received degrees from Rensselaer. After working several years on the Croton Aqueduct with his old 60th NY Commander, George S. Greene, Buck took an assignment in Peru working on the railroad running from Calao to Orroya. In 1872, Buck was placed in charge of building the Verrugas Viaduct. He was asked to design a new erection technique, to build the highest bridge in the world in one of the most remote areas, and to build it quickly with inexperienced help.

The Engineering Record reported that it was on this bridge he "laid the foundation for the reputation he ever since had of accomplishing difficult tasks with so little flourish that their difficulty was only recognized by fellow engineers." On March 23, 1889, the Viaduct was swept away after an "unusually rainy" season." Buck was retained as engineer for a new bridge. He designed a cantilever structure with anchor spans of 140 feet and a central span of 235 feet, including a suspended span of 105 feet. Buck's cantilever was removed in 1938, as the loads placed on it over 47 years since its construction were much heavier than those used in its design.

In 1877, Buck was asked to look at John A. Roebling's famous railroad suspension bridge over the Niagara River, in service since 1855. As a result of increased traffic, the bridge was showing signs of wear and the owners wanted to maintain its serviceability. Buck cut defective wires from the existing cable and replaced them. The Great Western Railway, which was using the structure, was not satisfied and insisted "upon a regular commission of engineers to examine every part, and to report upon it." This commission determined "the anchorages were small to specification...they advised that additional chain anchorage was necessary to the extent of 50 square inches of section to make this equal in strength of the cables." They also "suggested the removal of all the wooden truss and floor beams, and the substitution of iron." Buck was appointed engineer in charge of carrying out these recommendations and arrived at the site September 13, 1877. He finished the anchorage rehabilitation project and later replaced the wooden deck structure with iron, in less than eight months.

Roebling's stone towers deteriorated over time, and it was necessary to either reinforce or replace them to extend the useful life of the structure. Buck decided to build new wrought-iron towers around the existing stone towers, and transfer the load to the new towers without stopping traffic on the bridge. Buck's feat was called by *Engineering News* "the most delicate and daring piece of bridgework ever undertaken." *The Engineering Record* wrote "his reconstruction of the towers of the bridge, in 1886, is probably one of the most remarkable engineering achievements of our age, performed so modestly that until it was completed and the dangers of the work were explained by other men, few people knew that such an enterprise was even contemplated."

Buck's first opportunity to build an arch bridge was in Rochester, New York over the Genesee Gorge. He became chief engineer in 1888 and selected a three-hinged arch pattern to simplify the calculations. He designed the members so the bridge could be erected by the cantilever method, the first braced-spandrel bridge to be so designed. It was one of the early examples of a completely riveted long span bridge in the United States.

By the early 1890s, Roebling's Niagara bridge, as updated by Buck with its single track, outlived its usefulness. Buck received a commission to build a new two-level, steel arch on the same site, with two tracks on the top, without interrupting traffic.

When completed, his colleagues in the bridge building field acknowledged Buck's triumph. Henry Tyrrell wrote in his *History of Bridge Engineering*, "the opening of the Niagara Railroad Arch marked a new period in American bridge design. The remarkable example of modern engineering was completed in 1896 at a cost of $500,000." The bridge still stands after 100 years of serving railroad and vehicular traffic. It is the oldest structure spanning the river, and has fully lived up to the claim of *Engineering News* at its opening that it was "capable of serving the purpose, barring injury by corrosion, a hundred years from now as it is today."

Buck also had a 13 year involvement with the Niagara-Clifton Bridge at Niagara Falls, much like he had with Roebling's. The original suspension bridge, with a span of 1,268, feet was built at the site just below the falls by Samuel Keefer in 1868. In 1886, it was decided to widen the bridge and Buck was chosen as chief engineer. The bridgework was completed in the fall of 1888 while Buck was away on the west coast. About 11:00 PM on January 9, 1889, however, one of the greatest storms known to the Niagara region blew down the gorge, and the deck ripped away from the cables and crashed into the river below. Buck returned and reported on the cause of the failure. His advice was taken, and he was retained as chief engineer. The bridge was rebuilt by Buck in the amazingly short time of less than two (2) months and was opened for traffic on May 7, 1889. By 1895, with the advent of the electric trolley, there was pressure to create a loop railway that would connect existing lines on both sides of the gorge, with a bridge at the falls and one at Lewiston-Queenstown. Buck's suspension bridge was not designed for trolley traffic, so it was apparent the bridge would either have to be strengthened or replaced. He was retained as Chief Engineer of the new bridge, which was to be an arched structure with a span of 840 feet. It would be built around the existing suspension bridge and would not interfere with traffic throughout its construction. It would be the longest arch bridge in the world, exceeding by 276 feet that of the Duoro Bridge built in Portugal by Gustave Eiffel in 1876. Work on the erection of the superstructure began March 1, 1898 and was completed by June 30 of the same year.

The bridge served well for almost forty years, until January 25, 1938 when a major wind storm off Lake Erie jammed the river gorge below the falls with ice, and the ice crumpled main members of the bridge near the skewbacks resulting in the bridge collapsing on January 29th.

Another bridge was needed to connect Brooklyn with Manhattan was apparent shortly after the Brooklyn Bridge opened in 1883. Just before Christmas 1895, from the multitude of engineers applying for the position, the Bridge Commissioners selected Buck as chief engineer for what was to be the longest and most heavily loaded suspension bridge in the world. On July 22, 1896 his plans were approved. Contracts for the foundation, caissons and stone work, the two towers and two anchorages were let in 1897. Its opening in December 1903 was a great success, featuring a large parade in the afternoon. The bridge still stands today, carrying traffic over the East River.

Buck died suddenly in 1909, and much was written about him by his colleagues. He rarely, if ever, wrote about his own work other than to discuss technical issues. He said, "As to my work, I prefer to let the things I have accomplished speak for me." He was a man who accomplished much, building the highest bridge in the world at the time, the longest arch bridge in the world, the first major spandrel braced arch in the United States, four of the sixteen longest arch bridges in the world, and the longest and heaviest loaded suspension bridge in the world. His work in replacing most of the fabric of Roebling's Suspension Bridge while it was in service, and then building a two level arch bridge under and around it without stopping traffic, was exceptional engineering. His work at rehabilitating Keefer's Suspension Bridge at Niagara and then building another arch under and around it, while maintaining traffic at all times, was of a similar "heroic nature." He was "one of the heroic figures in the history of Engineering."▪

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