



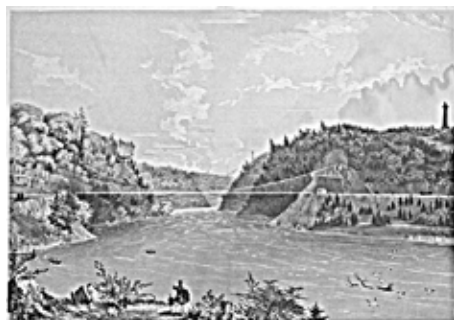
## General Edward W. Serrell

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

An early proponent of wire cabled suspension bridges, Edward Serrell accomplished much as an engineer in both the pre- and post- Civil War era. In addition to his structural works, Serrell was a grand concepthor, envisioning exotic, for the times, notions on helicopter-like flying machines and alternative routes to the Panama Canal.

Serrell was born November 5, 1826 in London, England, the tenth child of William and Ann Serrell. Since his parents were American citizens, he was a citizen of the United States. His family returned to the U.S. in 1831 and settled in New York City. He attended the local schools. At twelve years of age, he entered the Mechanic's School. At fourteen he started working with his father and brothers, John and James, in the civil engineering field. After serving his apprenticeship, he became an assistant engineer on the Erie Railroad in 1845 and later worked on the Central Railroad of New Jersey. In 1846, at the age of 19, he was one of four engineers (Charles Ellet, John Roebling and Samuel Keefer) who responded to a request for proposals for a railroad suspension bridge across the Niagara River at the rapids. The contract was given to Ellet who built a temporary bridge across the gorge in 1849, followed by Roebling's bridge in 1855.

After working on the Atlantic Dock in Brooklyn, he moved to New Hampshire to work on the Northern Railroad. Then he went to New Jersey to work on the Somerville and Elizabethtown Railroad, followed by the extension of the Harlem Railroad in New York City. In 1848, he went to Panama with U.S. Topographical Engineers to conduct surveys upon which the general line of the Panama Railroad was constructed and various canal routes explored.



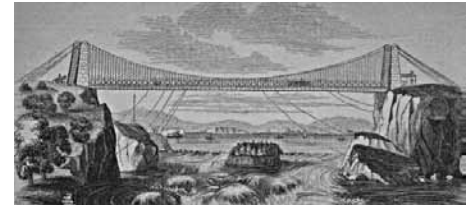
Lewiston-Queenston Bridge 1851.

In 1851, he built his first suspension bridge across the Niagara River between Lewiston, New York and Queenston, Canada. The bridge had a deck length of 841 feet with a cable length from tower to tower of 1,040 feet. The towers on both sides of the river were short, resulting in short back spans. A print, circa 1855, by William Beard called it "the largest in the world, built in 1850."

Construction started (1850) and the bridge opened on March 20, 1851. Charles Ellet and John A. Roebling bid on the bridge, but the Commissioners chose Serrell. He had wind guys dropping down for the deck to anchorages on the shore. In early 1864, the Commissioners were worried about ice jams and removed the wind guys, and when the danger was past, they neglected to restore them. Unfortunately, with the wind guys off, the deck fell into the river on February 2, 1864 in a windstorm. The bridge remained in that state until 1899 when it was rebuilt by Leffert and Richard S. Buck.

After the success of his Lewiston/Queenston Bridge, he was called to review several sites and design a much longer railroad/roadway suspension bridge over the St. Lawrence River at Quebec. He proposed a bridge with a central span of 1,610 feet and side spans of 805 feet for the Grand Trunk Railway. His hollow masonry towers were 330 high and 52 by 137 feet at the base. Roebling had not yet started his 820-foot span railroad bridge over the Niagara, and Serrell was proposing a bridge over twice as long. The design provided a 32-foot wide deck with two 10½-foot roadways flanking an 11-foot space for a single railroad track, much like the original plans for the Niagara Bridge.

In the cover letter of his report he stated, "I see no insurmountable engineering difficulties in the case; no reason for thinking that a substantial Bridge, suitable for railway and other travel, cannot be built here..." He recommended a site near the Chaudiere River and concluded, "Gentlemen of Quebec, you must either build a bridge or a new city." To support his position, he wrote a 65 page treatise entitled *Report on a Railway Bridge Proposed for crossing the St. Lawrence River at Quebec made to His Worship the Mayor and the City Council*. It was a very complete report, giving the history of suspension bridge design including the works of the Europeans



St. John Bridge, Gleason's 1853.

as well as Ellet and Roebling. Due to objections from the city of Montreal, the project was not funded and a bridge would not be built across the river at Quebec until 1917.

In 1853, Serrell built a suspension bridge at St. John, New Brunswick, the site of the famous Reversing Falls. The span was 830 feet in length. The towers were built with heavy blocks of granite and were one hundred and sixty feet above the river. Many attempts were made previously to span the river but failed due to the strength of its currents. A portion of the deck at mid span failed in a windstorm in February 1858 and was replaced. It was rebuilt in 1887 and survived until 1915.

Along with William Kennish, he prepared a report in 1855 to F. M. Kelley on the Atrato River canal route entitled, *The Practicability and Importance of a ship canal to connect the Atlantic and Pacific Oceans with a History of the Enterprise*. Serrell himself wrote the section entitled, "Confirmatory Report of E. W. Serrell, Esq., Consulting-Engineer" in which he also reviewed many other possible routes for a canal across Central America.

He then worked on the Brooklyn water-works plan, the water-works at Bridgeport, Conn., St. John, N. B., and the North Carolina Western Railroad, a railroad in Iowa, and a bridge over the Mississippi. In 1855 he turned his attention to the construction of the Hoosac Tunnel in Massachusetts for the Troy and Greenfield Railroad. In February 1856, he and Herman Haupt were awarded the contract to dig the tunnel. In July of the same year, the firm was dissolved and the contract transferred to H. Haupt & Co. Serrell was named a consulting engineer.

His next project, in 1857, was for a large bridge in England over the Avon River, near Bristol. A competition was held in the late 1820s and Isambard Kingdom Brunel's design for a suspension bridge was selected, with a span of 703 feet. Construction started in 1831 but was stopped in 1843 after only the towers were completed. Proposals were solicited in 1857 to complete the bridge, possibly using new plans. Serrell's plan was for a single span of 703 feet, with a clearance over the river of 245

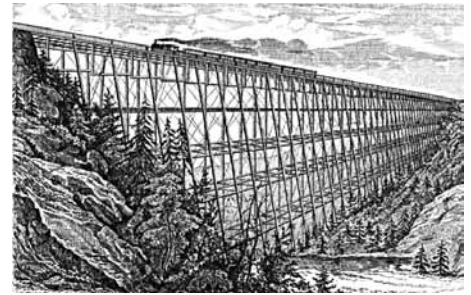
feet. It would have been the longest span bridge in England. He was the first American engineer invited to make a proposal for a public work of this kind in England. *The Civil Engineers and Architects Journal*, December 1857, noted:

*"... The cables, although of wire, are composed of great numbers, and are bound together in solid masses: it is intended to have so many strands that, collectively they will carry seven times their own weight and the weight of the suspending-rods and roadway, and seven times as much weight upon the roadway as it would have upon it if filled quite full and crowded with people. The cables will be carried over the towers, and secured in anchor-pits on the rocks, in the usual manner..."*

His plan was not accepted. The final plan used wrought iron chains rather than Serrell's wire cables and was opened in 1864.

Serrell was a Major in the 8<sup>th</sup> Militia regiment of the State of New York before the Civil War. From his office at the Raritan and Delaware Bay Railroad, he wrote a letter to President Lincoln noting that he even though he had not supported him for President, "I feel bound so say to you in this hour of trial that my humble services, whatever they may be worth are at the disposal of your government." He then raised the 1<sup>st</sup> New York Volunteer

Engineer Regiment and was, shortly after, elected its Colonel. The regiment was formed "to assist the regular U.S. Army's small corps of engineers with a volunteer unit that would be largely topographical engineers along with a regiment of mechanics and artificers." One of his most well known achievements in 1863 was the construction of the "Swamp Angel," a heavy gun emplacement that had the range to reach Charleston from a peninsula at Hampton Roads. It was built in a marsh and required unique methods to stabilize the soil to receive the gun. He finished his army career in Benjamin Butler's Army of Virginia and was sent by Butler to New York to work on a flying machine for which he claimed to have found "the method of navigating the air by means of elevating fans." One set of fans was to raise the ship and the others, front and back, to propel it horizontally using high-pressure steam boilers to work the propellers. When General Ord replaced Butler, he wanted to know what Serrell was doing in New York. When asked, Serrell indicated he was on recruiting duty. The army tried to force him out, but he instead resigned to protect his image. He was mustered out the service in February 1865 and was brevetted brigadier general of volunteers in March of the same year.



Lyman's Viaduct, Serrell and Clarke.

Returning to New York City he set up an office at 78 Broadway, offering to design "RAILROADS, BRIDGES AND EXPLORATIONS, SERRELL'S PATENT WROUGHT IRON VIADUCTS." His next major project was for a railroad/wagon bridge to cross the Hudson River at its narrowest point near the present day Bear Mountain Bridge. The bridge was chartered in 1868 as the Hudson Highland Suspension Bridge Company. Serrell was named its chief engineer, and he designed a double deck bridge with 1,665 feet between towers that was 155 feet above the river level. It had 20 cables, each 14 inches in diameter. It would have been much larger than any bridge built at the time and twice as long as Roebling's Niagara span with two decks. Serrell's bridge carried roadway (lower) and railway (upper) traffic. The project

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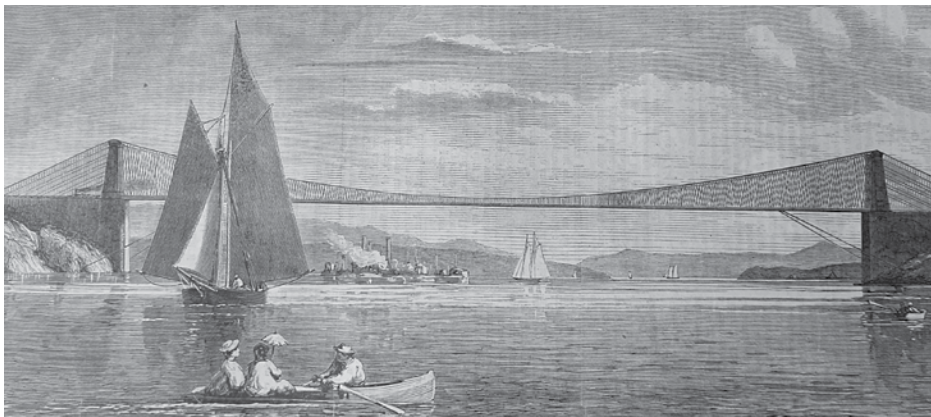
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Hudson Highland Bridge as proposed by Serrell 1868, Harper's Weekly.

was not funded at the time, and it finally died when the Poughkeepsie Railroad Bridge was opened just upstream in 1889.

He was appointed chief engineer of the New Haven, Middletown and Willimantic Railroad in 1870, on which the well known Rapallo and Lyman Viaducts were built. He apparently had trouble with the designs and approached Clarke and Reeves & Company, under T. C. Clarke, to submit a design for the wrought iron viaduct. The plans were completed in 1872. Serrell still did not trust the design and authorized traffic on only one track rather than the called for twin track line. After leaving the line, he wrote a letter to the governor of Connecticut

expressing his concern about safety of the bridge. James Laurie, former president of the American Society of Civil Engineers (ASCE), was then called in to report on the viaducts. He determined they were both well designed and able to carry the load specified by Clarke.

In 1888, Serrell became president of the Washington County Railroad (now Vermont Rail System) running 56 miles from Greenwich, New York to Rutland, Vermont. He then returned to his interest in an isthmian canal. He talked with President McKinley in September 1901 about his project and wrote that McKinley seemed to be agreeable to his proposed route, but that McKinley stated, "this must be

harmonized, see if you can arrange a plan to harmonize." McKinley was assassinated a few days later on September 6, 1901. In 1902, at the age of 76, Serrell was still promoting his Darien (San Blas) route for the isthmus canal and on January 18 made a presentation to the Isthmian Canal Commission for the American Isthmian Ship Canal Company. He sent a letter to the editor of the *New York Times* on the project on December 14, 1903, after a treaty was signed with Panama, and was critical of the Panama Route. In supporting his route he stated, "By it not only will the United States and the whole world get a canal adequate to do the business to be done, instead of, as at Panama, having a rain-water canal with locks, having less than one-tenth of the business ability of the Darien, but by the method provided by the Pugsley bill the Government will save the entire cost of construction of the canal, and expenditures variously estimated at from \$180,000,000 to \$250,000,000, and several years of time, because the Darien-Mandingo route can be built much quicker than any other." His plan was for a sea level canal with a huge tunnel. In 1904, he wrote a 16 page pamphlet, *The American Isthmian canals: The Darien Mandingo canal*, in support of his proposal. His route was not accepted. He wrote again about his attempts at a flying machine during the Civil War in article entitled

*A Flying Machine in the Army* on June 24, 1904 in *Science*. This was after the Wright Brothers first flight but before public flights in 1908. In it he described experiments with a helicopter-type machine made (unsuccessfully) by officers of the Northern Army during the Civil War.

Serrell died on April 25, 1906, at Rossville, New York and is buried in St. Luke's Cemetery. One source noted, "He is a young man who may be considered a good example of what patient, enduring, energetic, determined action will accomplish. Without fortune or family influences, he has, by his own unaided industry and natural talents, won his way to his present high position in an honorable and useful profession." He, along with Charles Ellet and John A. Roebling, developed the use of the wire cable suspension bridge in the United States. ■



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*Dr. Griggs specializes in the restoration of historic bridges, having restored many 19<sup>th</sup> Century cast and wrought iron bridges. He was formerly Director of Historic Bridge Programs for Clough, Harbour & Associates LLP in Albany, NY, and is now an independent Consulting Engineer. Dr. Griggs can be reached at [fgriggs@nycap.rr.com](mailto:fgriggs@nycap.rr.com).*