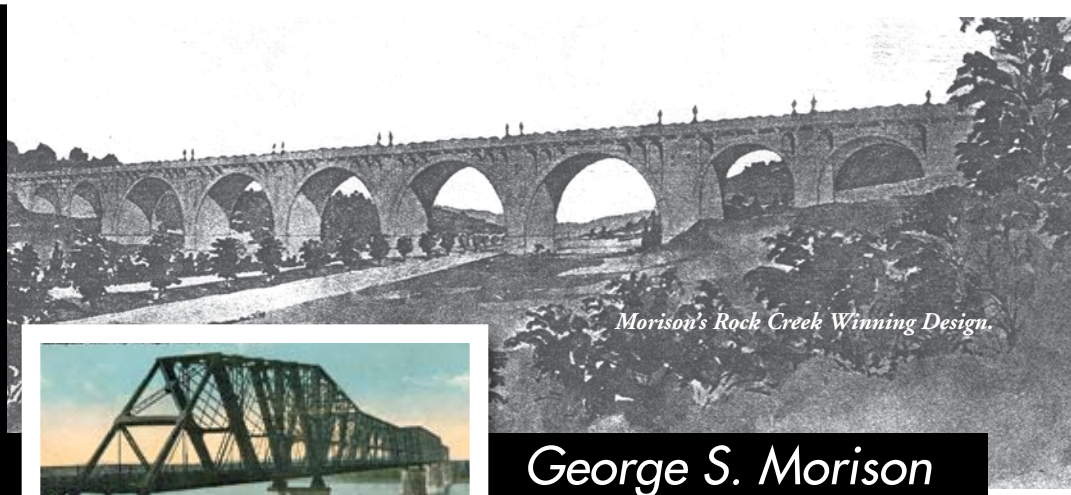


Morison's Rock Creek Winning Design.

Memphis Bridge Plan.

George S. Morison

Pontifex Maximus

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

Morison was born in New Bedford, Massachusetts on December 19, 1842, the son of a Unitarian Minister. He attended Phillips Exeter in New Hampshire, after which he began his studies at Harvard in 1859. He graduated in 1863. After a year in South Carolina, he returned to Harvard to study law, receiving his degree in 1866. He went to work in New York City and was admitted to the Bar shortly after. Apparently Morison found the practice of law was not to his liking and decided to enter, without previous training, the field of civil engineering.

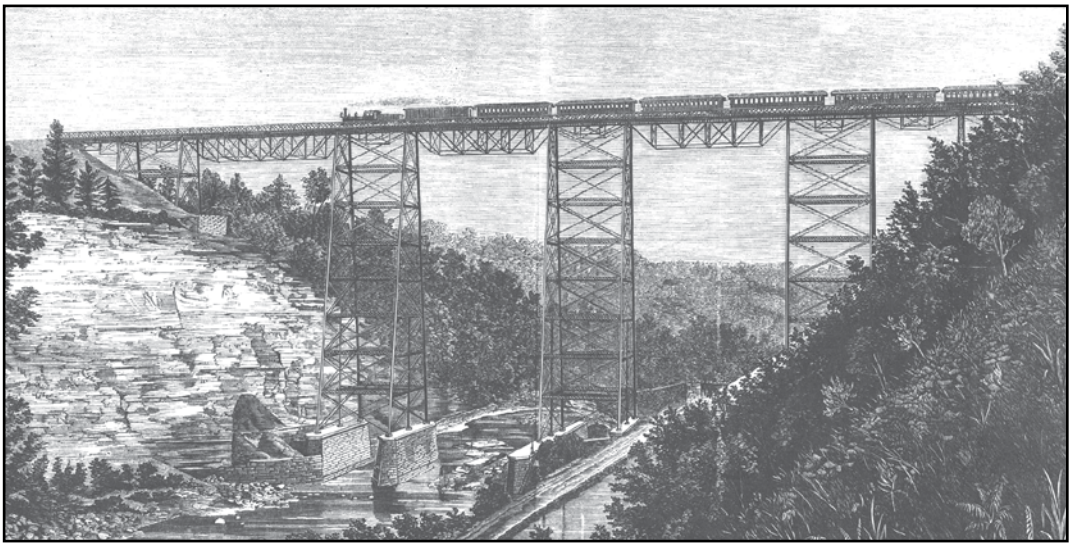
He was recommended to Octave Chanute, who was appointed Chief Engineer on the construction of the first railroad bridge across the Missouri River at Kansas City. Morison arrived at the site on October 16, 1867 after the preliminary designs had been completed.

Morison could not have found a better project, or a better mentor, to begin his career in Civil Engineering. A Kansas City newspaper reporting the opening of the bridge noted, "The method employed in building this pier #4, which is a great triumph of engineering, was suggested by the Chief Engineer, Mr. Chanute, but the details were all worked out by a young Massachusetts man, Mr. G. S. Morison, who bids fair to take a high rank among civil engineers."

Chanute was then named Chief Engineer for several railroads in Kansas. Morison went with him as his assistant on the Leavenworth, Lawrence and Galveston Railroad where he remained until June 1871. In July 1871, he was given his first job as chief engineer on the Detroit, Eel River and Illinois Railroad. After two years, he followed Octave Chanute to the Erie Railroad as his chief assistant. At the time the Erie planned a $50,000,000 upgrade, but shortly after they arrived the financial panic of 1873 made this plan impossible as the anticipated investment by English financiers disappeared.

A major challenge came March 17, 1875 when a large ice jam took out the five-span, double track, bridge over the Delaware River near Port Jervis, NY. After building a temporary wooden bridge, Morison, with the Watson Bridge Company of Paterson, NJ, replaced the structure within 40 days after its collapse. Their next, and very similar, crisis was the replacement of the Portage Bridge, near Hornell, NY, over the Genesee River that was destroyed by fire May 6, 1875. Given the importance of the line, it was necessary to have a new iron bridge in the shortest possible time, which turned out to be 86 days.

Morison left the Erie Railroad in late 1875 and formed a construction company with George S. Field, based in Buffalo, NY. Morison was also acting as a representative for the Baring Brothers, a London financial institution, as British investors were primary stockholders in many American railroads. His work with Field and Barings over the next five years had him traveling over much of the country observing work on the lines, and



Portage Bridge Engraving.

methods used in building and maintaining the bridges.

In 1880 Morison left Field and became a consulting engineer, receiving major contracts to build bridges over the Missouri, Ohio, Columbia, Snake, Des Moines, St. Johns, and Mississippi Rivers. A listing of his major bridges over the next 21 years is shown in *Table 1*.

His first contract for a major bridge of his own came when the Chicago, Burlington & Quincy Railroad determined it needed a bridge across the Missouri at Plattsmouth, Nebraska. His design was for two 400-foot Whipple through truss spans with three 204-foot deck spans. It opened to traffic in 1880. Much of this bridge was wrought iron, but in subsequent bridges he gradually changed to all steel for his main truss work.

With success of the Plattsmouth bridge, Morison established himself as one of the leading bridge engineers in the United States. This led to contracts to design the Bismarck Bridge in North Dakota and the Blair Crossing Bridge in Nebraska, both across the Missouri. He also built his second viaduct, the Marent Gulch Viaduct in Montana, as well as bridges across the Snake and Columbia Rivers before being given the job of rebuilding the Omaha Bridge.

In February 1887, he was asked by the Illinois Central Railroad to review a design for a bridge across the Ohio River at Cairo, just above its intersection with the Mississippi River. On this project he worked with a classmate from Philips Exeter, Elmer Corthell. They inspected the site and submitted a final report on March 23rd. What they recommended was the longest bridge in the world with 52 spans of Whipple trusses, for a total length of 10,560 feet and a height above high water of 53 feet. The last project Corthell and Morison worked on as partners was the Merchants Bridge across the Mississippi at St Louis. Its three main channel spans, carrying twin tracks, were approximately 521 feet long.

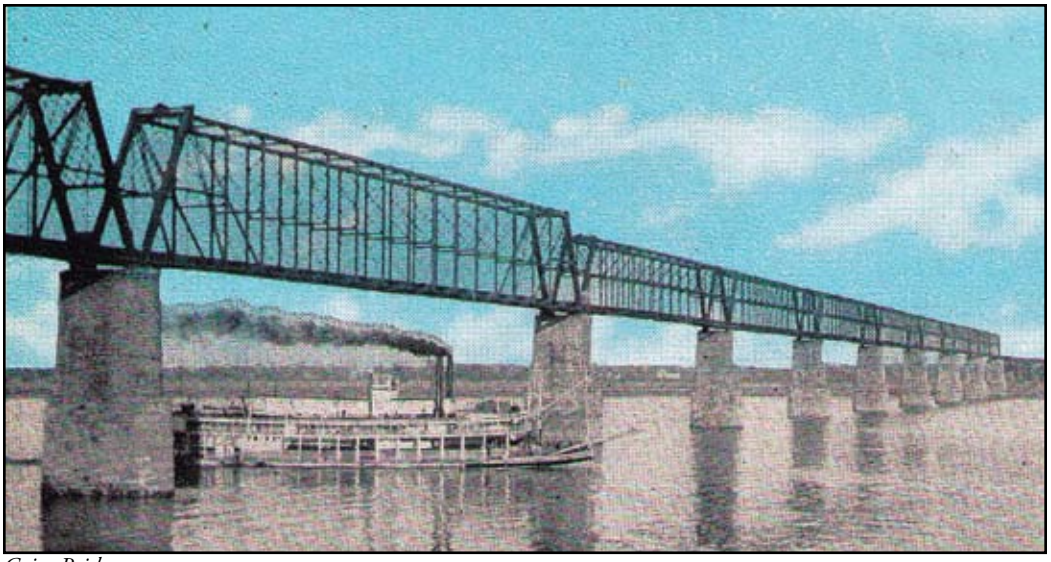
While Morison built many other major bridges, perhaps the greatest bridge was his huge cantilever bridge over the Mississippi River at Memphis, Tennessee. The authorization from Congress was granted on February 26, 1885 with the following conditions: The channel spans were not to be less than 550 feet, no span could be less than 300 feet and the minimum clearance was set at 65 feet above extreme high water. Troubles with the original charter required a new company to be formed that went back to Congress in the winter of 1886-87. The new charter required the main

Year	Location	River	Main spans
1880	Plattsmouth MO	Missouri	2@400’
1882	Bismarck, ND	Missouri	3@400’
1883	Blair Crossing, NB	Missouri	3@220’
1884	Ainsworth, WA	Snake	
1884	Belknap, MT	Clarks Fork, Columbia	
1884	Marent Gulch,	Marent	3@140’, 2@128’ 4”
1887	Omaha, NB	Missouri	4@246’
1888	Sioux City, SD	Missouri	4@400’
1888	Nebraska City, NB	Missouri	2@400’
1889	Rulo, NB	Missouri	3@375’
1889	Willamette, OR	Willamette	1@325’, swing 340
1889	Cairo, IL	Ohio	2@518’, 7@400’
1889	Riparia, WA	Snake	2@325’, swing 324’
1890	St. Louis, Merchants	Mississippi	3@520’
1890	Jacksonville FL	St. Johns	4 fixed, swing
1891	Winona, MN	Mississippi	1@360’, swing 440’
1893	Bellfontaine, MO	Missouri	4@440’
1893	Leavenworth, KS	Missouri	2@320’, swing 450’
1893	Burlington, IA	Mississippi	6@248’, swing 356’
1893	Memphis, TN	Mississippi	1@621’, 1@790’
1894	Alton, IL	Mississippi	1@360, swing 450’
1898	Atchison, MO	Missouri	
1901	Boone, IA	DesMoines	1@300’, 39 girders

Table 1: Morison’s Major Bridges.

channel span to be not less than seven hundred feet and the clearance not less than seventy-five feet. Morison designed the bridge to these new requirements and construction started in late 1888. It opened on May 12, 1892 and still spans the Mississippi.

The Railroad Gazette called it, "one of the greatest bridges of the world, one that is remarkable not only for the length of the span, but for the depth of the foundations, the originality of the methods used in erecting them, and for the simplicity and skill in its design. No bridge anywhere nearly as remarkable has ever been so quietly built."



Cairo Bridge.

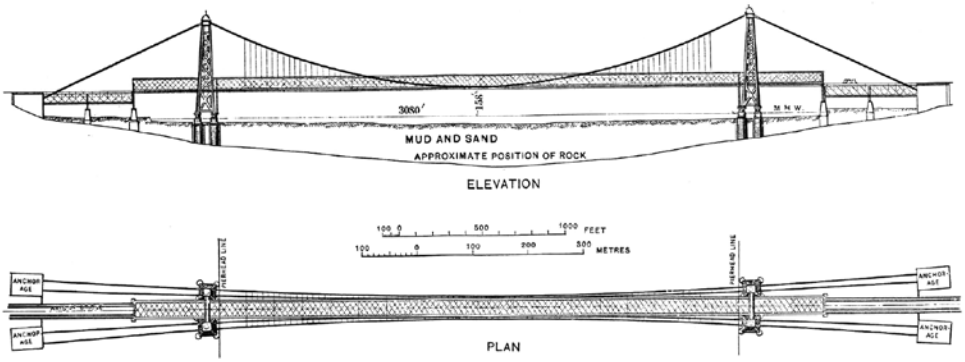
Noting the success of Gustav Eiffel's 300-meter tower at the Paris World's fair, the organizers of the Chicago Columbian Exposition in 1891 solicited proposals for a tower of equal or greater height. Morison organized a group of men including Andrew Carnegie, the Keystone Bridge Company and others, called the American Tower Company, to submit a proposal for a 1,120-foot tower. They indicated that it could be built for $1,500,000 and in time for the Exposition. After an early show of interest by financiers, it was clear that Morison and his group could not finance the project.

Due to the financial panic of 1893 to 1900, bridgework was slow and Morison devoted most of his time serving on various panels of engineers called to advise on various major projects. The first was a panel in 1894 to recommend to the Secretary of War "what length of span, not less than 2,000 ft., would be safe and practicable for a railway bridge across the Hudson River between 59th and 69th Street." The panel concluded that "a single span from pier-head to pier-head, built on either the cantilever or suspension principle, would be safe. The estimated cost of the 3,100 foot clear-span cantilever being about twice that of the shorter span your Board considers themselves justified in pronouncing it impracticable on financial grounds...While from such a professional view they must pronounce the suspension bridge practicable, they do not in this conclusion give an opinion on the financial practicability and merit of either plan." Based on these studies, the Secretary of War disapproved the proposed cantilever of the New York and New Jersey Bridge Company across the Hudson River.

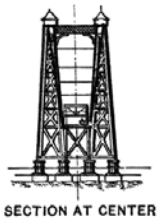
Morison then proposed a design of his own in a major paper in the *Transactions of the ASCE*. Morison estimated the bridge, using steel towers, could be built for $22,500,000 and be finished within five years. No action was taken on his design.

In 1895, he was elected President of the American Society of Civil Engineers. He submitted a design in a competition for the Rock Creek Bridge in Washington, DC. He won the competition and the bridge was built to his design, opening after his death in 1907. In 1927 Wilbur Watson wrote, "Considered either from the viewpoint of the engineer or architect this work must be conceded to be one of the finest, if not the best executed concrete bridge yet built."

His next major assignment, as a member the Isthmian Canal Commission appointed to advise President McKinley, was on where to build a canal across Central America. The committee initially determined Nicaragua was the best route, but Morison wrote a minority report that argued that the Commission was wrong in assuming the New Panama Canal Company would not sell its property



Morison's North River Bridge Design.



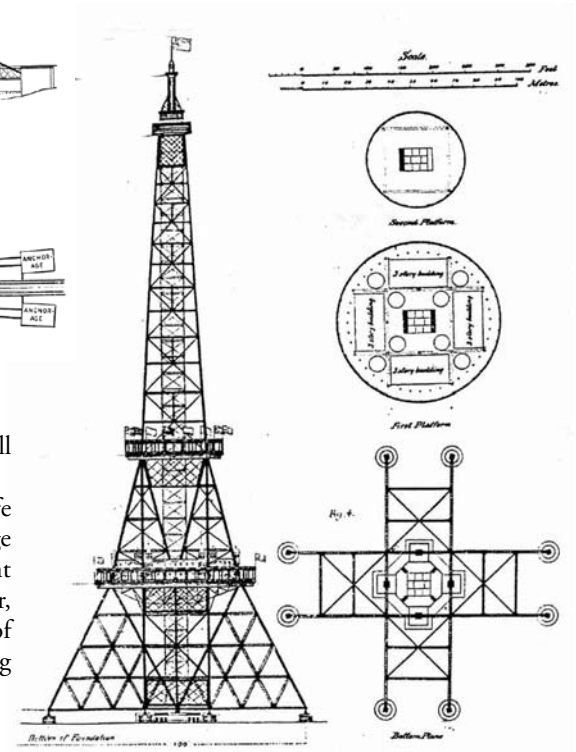
and rights to the United States for a reasonable sum. Largely due to the debate Morison's report generated, the New Panama Company agreed to sell its rights and property to the United States for $40,000,000 in early 1902. The Commission issued a supplemental report on January 18, 1902, recommending the Panama route. The record is clear that, without George Morison, the United States would probably never have built a canal at Panama.

He was one of five engineers to advise the mayor of New York on whether the Manhattan Bridge should be built to the plans of Gustav Lindenthal, with steel braced chains, or the design of R. S. Buck with wire cables. Morison's panel agreed with Lindenthal, but with a change in administration the bridge was built with wire cables. Morison also advised on the safety of the cables of the Williamsburg Bridge that were damaged by fire in late 1902. Other panels he served on included a panel to determine the best location of a harbor near Los Angles, one on the best route for a New York State Barge Canal, and one to recommend the best manner to enhance the waterfront of New York City.

He became sick in May 1903 and never recovered, dying on July 1, 1903. Many of his colleagues reflected on his career in the professional journals. A summary of his life by one of his nephews was:

"He was in truth a dominant figure physically as well as intellectually. He was nearly six feet tall, and during his later life weighed about 225 pounds. His physique was well suited to his mentality. Force was perhaps the most striking impression one received upon meeting him. He spoke slowly, choosing his words carefully, and expressing himself so clearly as to leave no doubt as to his meaning… But the one word which guided all his actions, and which was the foundation for all of his achievements, is that word which stands alone on the blue stone in the Pine Hill Cemetery in Peterborough, VERITAS."

What better way of summarizing a life as full and rewarding as that of George S. Morison. A man whose commitment to truth shaped his engineering career, and to an extent the development of the United States and Civil Engineering profession between 1867 and 1903.▪



Morison's proposed Columbian Exposition Tower.

Dr. Griggs specializes in the restoration of historic bridges, having restored many 19th 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 via email at ***fgriggs@nycap.rr.com****.*