John Alexander Low Waddell

Genius of moveable bridges

By Richard G. Weingardt, P.E.

John A.L. Waddell, Photo Courtesy of Hardesty & Hanover

During the Depression years in the early 1930s, two of America's most decorated, honored and respected engineers occupied a small office building – a brownstone carriage-house converted into office suites – on the waterfront in lower New York City (NYC). Both public-spirited men, in their 70s, had founded noteworthy consulting engineering firms that had seen better days – both would live to see them recover and grow again. But through these times, these two persistent engineers were sharing not only cramped quarters, but members of their bridge staffs.

The taller and younger of the two, William Parsons (founder of Parsons Brinckerhoff) owned the building. While he was famous for tunneling and engineering the NYC subway, the subject of our story, John A.L. Waddell, was the acknowledged dean of U.S. bridge engineers, especially for massive moving bridges, with many significant projects completed worldwide.

Both were dignified, prolific writers and much sought-after speakers, who traveled extensively for business and pleasure. On the rare occasions when the two elderly engineering giants were in the office at the same time, it was awesome and exciting – and neither was adverse to holding court. Waddell, of medium height and a bit stout in his later years, with his silver-gray curly hair and splendid walrus-like mustache, often gave impromptu talks on big-game hunting and the art of salt-water fishing, pastimes at which he was world class.

His lectures on being successful at engineering and business usually stressed the need to be creative, to work hard, and to be prudent in the use of a client's money. Often, however, such addresses would conclude with statements like: "I am a firm believer in legitimate relaxation of every kind, and in man's getting all the pleasure he can out of life. The more you mix sports and amusements in with your work, the better will it be for you both physically and mentally, the longer will you live, the more will you accomplish, the more satisfactory will be the results of your work, the better men [and women] and citizens will you become, and the more interesting and agreeable will you prove to all with whom you are thrown in contact."

A fastidious dresser and always well groomed, Waddell was an impressive role model and mentor to many budding engineering superstars, including David Steinman (of Mackinac Bridge fame). In 1917, Steinman worked in Waddell's newly opened office in NYC where he acquired, according to Steinman, "the needed training regarding the business angle of engineering practice and the selling of engineering services. And good practice in making quick layouts and estimates for proposed bridges."

Waddell conveyed to young engineers that they have a moral obligation to share information with others to improve the profession and society. While instructing about the nuances of bridge engineering, he always stressed the importance of paying attention to economics and details, coining catch phrases like, "The science of bridge design lies mainly in the detailing." His governing motto was "integrity, thoroughness, progress and economics." These words were central to his thinking: he never tolerated waste of time, material or construction.

John Alexander Low was born in Port Hope, Ontario, Canada, on January 15, 1854. His father, Robert Needham Waddell, was born in Newry, Ireland and immigrated to Canada in 1831, when he was 16. He served as a captain in the Canadian Militia in 1856 and was appointed high sheriff of the United Counties of Northumberland and Durham in 1865. John's mother Angeline Esther Jones was the daughter of Colonel William Jones, the sheriff of NYC and a member of the state legislature.

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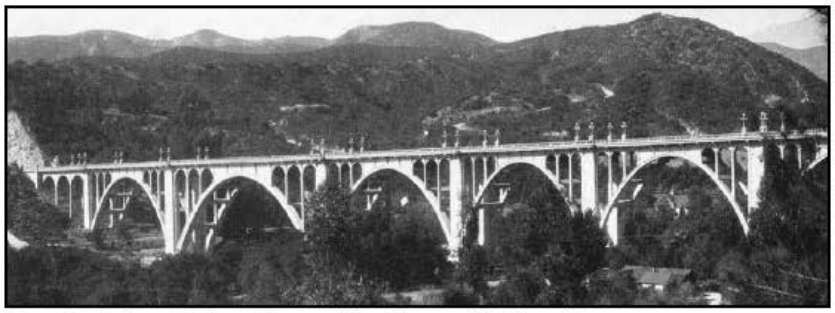


Arroyo Seco Bridge in Pasadena, CA, 1913, Photo Courtesy of Hardesty & Hanover

In contrast to his adult years when he was always in robust good health, John was not a healthy child. He was sandwiched in between two sisters, Josephine the oldest and Angeline one year his junior, and was home schooled by his mother until he was nine. A younger sibling Robert W., who like his older brother would become a civil/structural engineer, arrived when John was six.

In rather delicate health in his 16th year and slow in developing physically, John's parents sent him to China on the noted tea-clipper *N.B. Palmer of New York* as a cure. The ten-plus-month voyage to Hong Kong and Shanghai had the desired effect, and the young man gained greatly in health and strength. It also instilled in him a deep fascination for the East – and a lifetime case of wanderlust.

After studying at a business college in Toronto, John enrolled at Rensselaer Polytechnic Institute (RPI) in Troy, New York, where he graduated as a civil engineer in 1875. His first two jobs after graduation were with Canadian companies – the Marine Department of Dominion at Ottawa designing marine structures, and the Canadian Pacific Railroad doing railroad engineering.

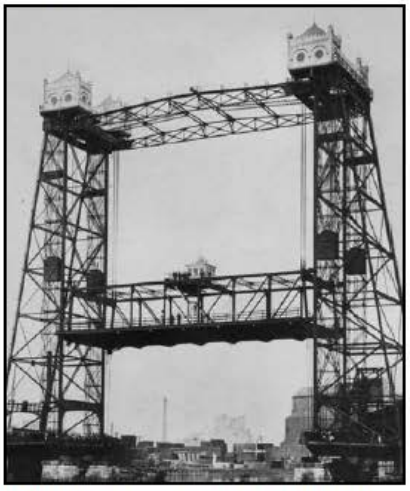
Waddell next moved to the U.S. to work as an engineer for a coal mining company in West Virginia doing engineering and surveying for mine structures, above and below ground. In the fall of 1878, he accepted a position as assistant professor at RPI in geodesy and descriptive geometry, then in rational and technical mechanics.

In 1881, Waddell took a position as chief engineer with Raymond and Campbell, bridge builders in Council Bluffs, Iowa. It was while there that the 27-year-old Canadian-turned-U.S. citizen developed his lifelong love for designing large bridges, a passion that would one day establish him as one of the world's greatest bridge builders.

From his earliest working days, Waddell wrote technical papers on a wide range of subjects, from railroads and bridges to lighthouses. Because of this, along with his experience designing bridges of note with Raymond and Campbell, and his reputation as a theoretician and educator at RPI, he attracted the attention of the Japanese government. It offered him the chair of the civil engineering department at the newly founded Imperial University of Tokyo, a heady position for a man still not yet thirty years old.

Prior to sailing for Japan in 1882, Waddell married Ada Everett, the only daughter of Horace Everett, a prominent lawyer in Council Bluffs. John and Ada would have three children – a daughter and two sons. One son, Leonard, would become a well-known Kansas City lawyer/realtor and the other, N. Everett, would become a civil engineer like his father – and eventually a partner in his firm.

During his four years in Japan, Waddell wrote his first book, *The Design of Ordinary Iron Highway Bridges*, which became the seminal text at major engineering schools throughout the world, the "gold standard" text on iron/steel bridge design. Also around this time, as he was preparing to leave the life of a professor, *Engineering News* published one of his major papers – "Civil Engineering Education," a comprehensive dissertation on improving engineering education overall. It set the stage for the direction that the training of engineers would take around the world.



Halstead Street Vertical Lift Bridge, Chicago, IL, 1894, Photo Courtesy of Hardesty & Hanover

Marine Parkway Bridge, NY, 1937, Photo Courtesy of Hardesty & Hanover

After returning to the U.S. in 1886, Waddell became the western agent in Kansas City, Missouri, for the Pennsylvania-based Phoenix Bridge Company. While employed by them, he also served as a consultant to several municipalities and local railroad companies. One of his major designs during this period was the Red Rock railroad bridge over the Colorado River between California and Arizona. At 660 feet, it was the longest cantilever span bridge in the U.S.

In 1887 at age 33, Waddell founded his own consulting engineering firm in Kansas City. In those days, many steel bridges built in the U.S. were ordered from a catalogue or purchased from salesmen representing steel companies and/or contractors, and the market was basically uncontrolled with an absence of building codes and material specifications. Owners had little basis for judging one catalogue bridge from another.

Waddell was among the first wave of U.S. private-practice engineers to establish a better concept, one where consulting engineers represented the client and prepared all the necessary design documents and contracts, then supervised the construction work of the firm that had secured the building contract through competitive bidding.

As a consultant, Waddell quickly established a reputation for creating daring and unusual structures. One of his first, in 1893, was a double track railway bridge across the Missouri River at East Omaha, Nebraska. Next came a highly innovative movable bridge, the South Halstead Street vertical-lift bridge in Chicago in 1894. It was the first important bridge of its kind to be constructed, and its success made large vertical-lift bridges acceptable worldwide.

By the early part of the 20th century, Waddell's client list included several dozen major railroads and numerous municipalities and governments worldwide. He designed more than 200 railroad bridges for the Vera Cruz and Pacific Railroad of Mexico, and a series of highway bridges in Cuba. In Canada, his Y-shaped railway and trolley bridge over the Fraser River at New Westminster, British Columbia, was the talk of the profession. Waddell's reputation had grown so widespread that industry leaders placed him at top of the world's great bridge engineers, a leading-edge designer, innovator and inventor.

In 1907, Waddell was appointed the principal engineer of the Trans-Alaska Siberia Company. This company planned to link European Russia with the U.S., building a line across Siberia through a tunnel under the Bering Strait to Alaska and through Canada. The plan was eventually abandoned because of international complications. The dream to link Alaska and Siberia, however, still exists.

Among Waddell's significant, movable steel-truss bridges built in the second decade of the 20th century was the 1912 ASB (Armour, Swift and Burlington) Bridge in Kansas City. It featured an ingenious lifting system – for which Waddell received a U.S. Patent – that eliminated the need for tall towers. The bridge was designated a National Historic Civil Engineering Landmark by the American Society of Civil engineers (ASCE) in 1995.

Other projects in Waddell's impressive portfolio included many noteworthy reinforced concrete bridges. Principle among them was the Colorado Street (Arroyo Seco) Bridge in Pasadena, California, opened in 1913. The multi-arch structure is on the National Register of Historic places and listed as a National Historic Civil Engineering Landmark by ASCE. Completed two years after the Colorado Bridge was Kansas City's Trafficway Viaduct, a double deck reinforced concrete structure.

In 1917, naming his son Everett as a partner, Waddell opened a second office in NYC with expectations of making it his headquarters. Bridge building in the U.S. began reviving right after World War I and both of the firm's offices did extremely well for three years, then tragedy suddenly struck - Everett died unexpectedly in 1920. Grieving, Waddell moved to New York full time. Assisting him throughout this time was Shortridge Hardesty, a brilliant engineer hand-picked by Waddell from RPI's stellar class of 1908. Hardesty soon became a partner, and the firm was renamed Waddell and Hardesty in 1927.

In 1921, Waddell was invited to China to judge a worldwide competition for designing the Peking-Hankow Railroad Bridge over the Yellow River. In 1929, he returned as engineering consultant to the Chinese ministry of railways and as advisor to the government for all civil works. By then, his impressive Newark Bay Bridge in New Jersey had been opened for three years. Its main spans consisted of a twin double track crossing, each with four vertical lift spans. During World War II, the bridge would significantly contribute to America's war effort by allowing 300-plus trains a day to transfer needed men and material to the port of New York for shipment to battle fronts.

Because of his management style and extensive traveling, Waddell frequently took on strong junior partners – a handful became full partners – to keep his company functioning during his extended absences. Because of that, Waddell had various partners and his company numerous names throughout its history: J.A. L. Waddell (1887-1898), Waddell & Hedrick (1899-1907), Waddell & Harrington (1905-1915), Waddell & Son (1916-1920), J.A.L. Waddell (1921-1926), Waddell & Hardesty (1927-1945) and finally Hardesty & Hanover (1945-present).

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Newark Bay Bridge, NJ, 1926, Photo Courtesy of Hardesty & Hanover

Waddell wrote voluminously his whole life, using long hours on railroad and steamship journeys to record his thoughts. His many important books on bridges and the engineering profession – in addition to his first one on iron highway bridges – include: *Bridge Engineering* (two volumes), *De Pontibus, System of Iron Railway Bridges for Japan, Principal Professional Papers, Economics of Bridgework, and Memoirs and Addresses of Two Decades.*

His countless state-of-the-art engineering papers were nationally and internationally acclaimed. For example, ASCE awarded him a record-setting three Norman Medals for his profession-altering writings, in 1909, 1915 and 1918. His 1909 and 1915 award-winning papers delved into the advances in using high-strength steel alloys for bridge design, while his 1918 winner addressed the economics of steel arch bridges.

Not all of Waddell writings dealt solely with engineering design. He was also the author of numerous general interest papers such as "Training for Engineers on Extemporaneous Speaking," and, as a world-class big game hunter and fisherman holding several world records, he was the author of many pieces for fishing and hunting publications. He also was an expert at Whist – serving thrice as president of the Kansas City Whist Club – and wrote many articles on that subject.

In addition to active participation in ASCE – where he was elevated to Honorary Member status – and the Western Society of Engineers, Waddell belonged to two dozen other engineering and scientific societies, institutes and academies, many of them international. He was a charter member of (and a driving force behind) three preeminent societies: the American Institute of Consulting Engineers (since merged into ACEC, which is now the American Council of Engineering Companies), the American Society of Testing Materials (now ASTM International), and the Society for the Promotion of Engineering Education (now ASEE).

In addition to his numerous U.S. awards and professional recognitions, Waddell was also highly honored by foreign governments including China, Italy, Japan and Russia. For his contributions to progress and engineering theory and practice – in particular, bridge design – he was awarded honorary memberships in the national engineering societies of Spain, Peru and China, and was a correspondent of the Academy of Sciences, Paris, France, and the Royal Academy of Sciences and Arts, Barcelona, Spain. He was the recipient of honorary degrees from several universities: Missouri, Nebraska, McGill and Puerto Rico, and the Imperial University of Japan.

When the flamboyant J.A.L.Waddell died in 1938 in NYC at 84 – four years after Ada, his devoted wife of 52 years – his company's fortunes were on the rise. In 1937, the firm's Marine Parkway Bridge, a four-lane, 540-foot vertical lift span structure, opened to much fan fare. Even today, it remains one of the longest vertical-lift bridges in the world.

Just before his death, Waddell was appropriately honored by the American Association of Engineers with its prestigious 1931 Clausen Gold Medal for "distinguished service for the welfare of engineers, social and economic" — a well-warranted citation that sat well with the old bridge man.▪

ASB Bridge, Kansas City, MO, 1912, Photo Courtesy of Jon Schmidt

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