JAMES BUCHANAN EADS.

This distinguished American engineer was born in Lawrenceburgh, Ind., May 23, 1820. As a boy he showed unusual fondness for machinery, and when but eight years old was in the habit of visiting places where it was possible for him to watch the movements of mechanical apparatus.

In 1829, he moved with his parents to Louisville, and while on the journey down the river, the lad showed such interest in the machinery on the boat that the engineer was induced to explain to him the operation of the principal parts of the engine. So well did he profit by this one lesson in steam engineering, that a little more than two years later, he constructed a miniature engine, which was worked by steam. Soon after settling in Louisville, his father, perhaps seeing something of the man in the boy, fitted up for him a workshop, where he constructed models of saw mills, fire engines, steamboats, and other machines. It is said that he used to take to pieces and put together the family clock, and when he was twelve years old, he accomplished a similar feat with a patent lever watch, having no tool but his pocket knife.

In 1833, the family again moved, this time to St. Louis. During the night following his arrival, the steamer which had brought him to St. Louis was burned, and all of his father's possessions destroyed. Young Eads, only thirteen years of age, landed barefooted, without a coat upon his back, on the very spot now covered by the abutments of the great steel bridge which he afterward built. No more schooling was possible, for it was necessary to aid in supporting his mother and sisters.

He began his independent career by selling apples on the street, and for some time followed this occupation, in order to obtain the necessities of life for the family. Before long, however, he secured a situation in a drygoods store, where he remained for five years. Meanwhile he had access to an excellent library belonging to the senior partner of the firm by which he was employed, and used every opportunity to study mechanics and cognate subjects.

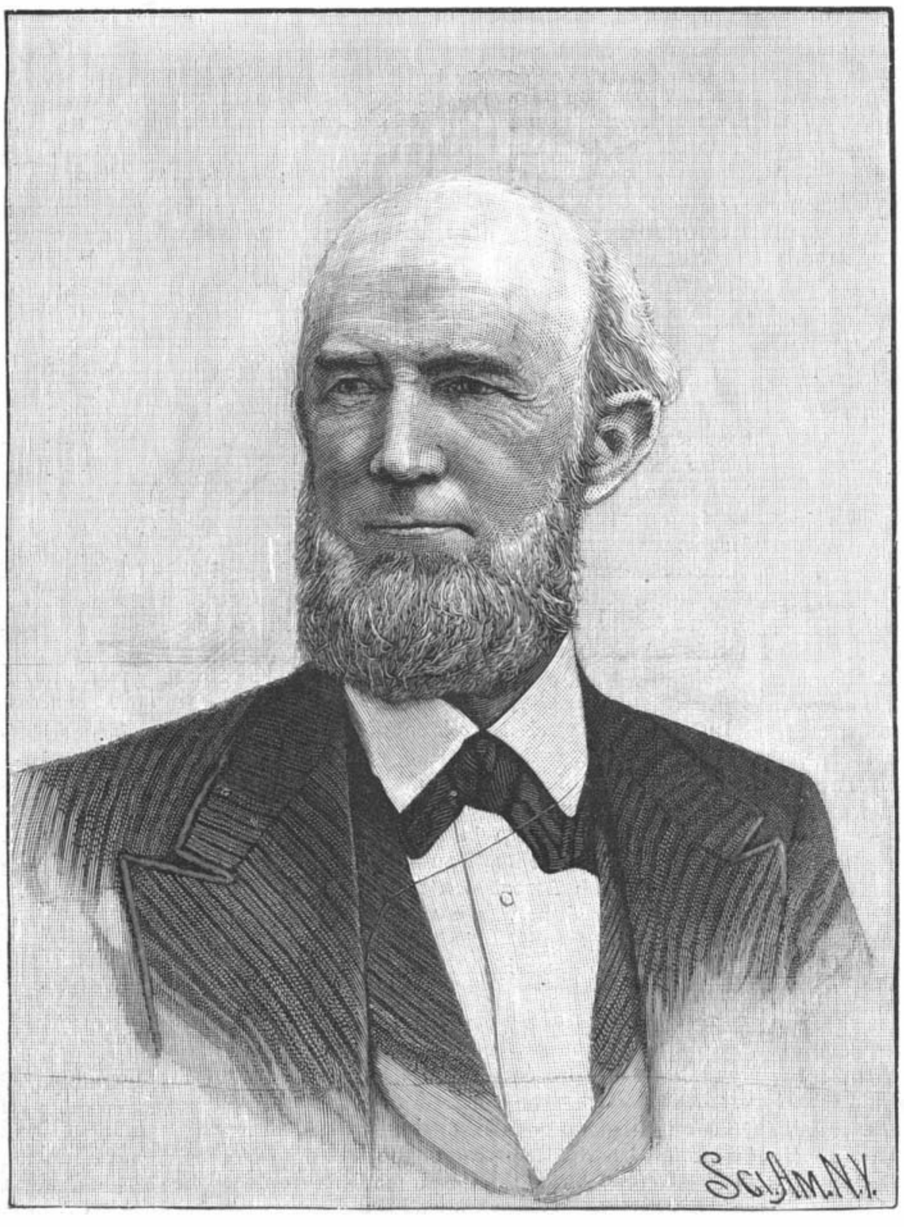
In 1839, he obtained the appointment of clerk on one of the Mississippi River steamers, and while holding this place began to acquire some knowledge of the waters of this capricious river, whose many changes have so bewildered its navigators. The shifting channels, now engulfing the rich plantations or flooding the large cities, were problems worthy of the greatest consideration, but time was not yet ripe for their adequate solution.

His attention was then turned to inventing, and in 1842 he designed a diving bell boat, to recover the cargoes of sunken steamers. Soon after, he formed a copartnership with Case & Nelson, boat builders, and constructed larger boats, with novel and powerful machinery for pumping out the sand and water from sunken vessels, and lifting their entire hull and cargo. This work was a thorough success, and the operations of the company extended from Balize, La., to Galena, Ills., and into the tributaries of the Mississippi. It was while engaged in the wrecking business that he gained a knowledge of the laws which control the flow of silt-bearing rivers; and he was able to say of the Mississippi a few years afterward, that there was not a stretch in its bed fifty miles long, between St. Louis and New Orleans, on which he had not stood on the bottom of the stream, beneath the shelter of a diving bell.

In 1845 he sold his interest in the company, and established in St. Louis the first glass manufactory west of the Ohio River. Two years later, this enterprise having failed, Mr. Eads returned to the business of raising steamers, removing obstructions from the channel, and improving the harbor of St. Louis. During the fire of 1849, twenty-nine steamers were burned at the landing of St. Louis and most of their wrecks were removed by him. This business proved financially successful, and in the following ten years he accumulated a fortune of half a million of dollars.

During the winter of 1855–6, Mr. Eads made a formal proposition to Congress to keep the channels of the Mississippi, Missouri, Ohio, and Arkansas Rivers free by removing all snags, wrecks, and other obstructions. A bill embodying his plans was reported on and passed the House of Representatives, but was unsuccessful in the Senate, owing to adjournment. Failing health led to his retirement from business in 1857, and the subsequent four years were spent without employment.

Three days after the surrender of Fort Sumter, on April 17, 1861, Mr. Edward Bates, then United States Attorney-General, wrote to him from Washington: "Be not surprised if you are called here suddenly by telegram. If called, come instantly. Under a certain contingency, it will be necessary to have the aid of the most thorough knowledge of our Western rivers and the use of steam on them, and in that event I have advised that you should be consulted." Soon after he was telegraphed for, and at once proceeded to Washington. After consultations with President Lincoln and others concerning the practicability of using light-draught ironclad vessels on the Mississippi and its tributaries, he was appointed, with Captain John Rodgers of the United States Navy, to carry into effect the recommendations which he made. He went immediately to Cairo, and there altered the Conestoga, Tyler, and Lexington into gunboats. In July, 1861, proposals were issued, calling for the construction of a number of ironclad gunboats for service on the Mississippi. Mr. Eads was found to be lowest bidder, and he was ordered to build seven vessels. The contract to finish these boats within sixty-five days was signed on August 7. The timber to form their hulls was still uncut, the rolls for the manufacture of the armor plates were not in existence, and the engines were nothing but pig iron and bars, yet in forty-five days (October 12, 1861) the St. Louis—the first United States ironclad—with her boilers and engines on board, was launched at Carondelet, near St. Louis. Ten days later the Carondelet followed, and then in rapid succession the Cincinnati, Louisville, Mound City, Cairo, and Pittsburg were launched. An eighth vessel, larger, more powerful, and superior in every respect, was undertaken before the hulls of the first seven had fairly assumed shape. Dr. Charles B. Boynton says, in this connection: "Thus one individual put into construction, and pushed to completion within a hundred days, a powerful squadron of eight vessels aggregating five thousand tons, capable of steaming at nine knots an hour, large, heavily armed, fully equipped, and all ready for their armament of one hundred and seven large guns. The fact that such a work was done is nobler praise than any that can be bestowed by words."



JAMES BUCHANAN EADS.

During 1862–3 he designed and constructed the Osage, Nesho, Winnebago, Milwaukee, Chickasaw, and Kickapoo, six turreted iron vessels, all heavily plated. The turrets on these were quite different from those of Ericsson and Coles, and their guns were worked entirely by steam. In this way, the eleven and fifteen inch guns could be loaded and discharged every forty-five seconds, and this record stands as the first application of steam in manipulating heavy artillery. In addition to the fourteen heavily armored gunboats already constructed, he converted, during the same time, seven transports into what were called "tinclads," or musket-proof gunboats, and also built four heavy mortar boats during this period. The good work which these vessels did during the war is recorded in the history of Generals Grant and Halleck's campaigns and of Admiral Farragut's capture of Mobile.

Soon after the closing of the civil war, the bridging of the Mississippi became urgent, and in 1865 a bill approving of the construction of a bridge at St. Louis was passed, but it was not until August, 1867, that work was begun. In the construction of this bridge Mr. Eads had to deal with problems which had not before confronted an engineer. It consisted of three arches, of which the central one has a clear span of five hundred and twenty feet, and is recognized as "the finest specimen of metal arch construction in the world," while the side arches are five hundred and two feet each in span. Its granite piers all rest upon the bed rock underlying the river deposits. Two of them are much deeper than any yet built, and of these, one, weighing forty-five thousand tons, was sunk to the bed rock, one hundred and thirty-six feet below high water mark, through ninety feet of sand and gravel, while the other, weighing forty thousand tons, is founded on the rock one hundred and thirty feet below high water mark. Many novel plans were designed by Mr. Eads in the construction of the caissons by which these enormous piers were sunk through the sand to the rock. In the erection of the arches, new problems likewise presented themselves. They had to be designed about two and a half inches longer than they are now in their present position, on account of the contraction which their weight causes throughout the arch. They were built out from the piers until they met at the center. The half spans near the shores of the river were upheld by huge iron guys passing over temporary towers on the piers and anchored securely on shore. On the central piers the half spans balanced each other, being built out from opposite sides of each pier. The central tubes had to be specially fitted for insertion, and their introduction was accomplished by the use of a set of telescopic tubes specially designed for this purpose by Mr. Eads. Each one of the original tubes was cut in two parts, and the two severed portions joined by an internal iron plug in which was turned a right and left screw fitting into corresponding threads turned on the inside of the tube ends. Several inches of the tube's length were cut out to permit it to be shortened up, so as to enter the space. Through the plug, pin holes were made for the insertion of strong levers by which it could be turned. By this simple method all of these enormous arches were closed. After an expenditure of exactly $6,536,729.99, this bridge was opened with appropriate ceremonies on July 4, 1874.

The deepening of the mouth of the Mississippi was a problem to which the attention of the people had already been drawn. In 1872 a commission of seven distinguished army engineers was directed by Congress to examine this subject. It reported in favor of building a canal through the left bank of the river, near Fort St. Philip, to connect with Breton Bay, by which the bars at the mouth of the river would be avoided entirely. This plan was opposed by Mr. Eads, who offered to undertake the deepening of the mouth of the Southwest Pass by a system of jetties at the sole risk of himself and his associates, without demanding any pay whatever from the government until after 20 feet should have been secured, the normal depth on the bar being about 14 feet.

Mr. Eads' proposition at once met with the decided opposition of the official experts of the United States Engineering Corps, to whom the government was in the habit of intrusting such work; but ultimately his plan was accepted, and he was allowed to begin operations on the South Pass, the smallest of the three, where, instead of a single bar with 14 feet on it, he was confronted with two, one in the sea with but 8 feet on it and one in the river with but 14 feet on it. In 1875 he began the construction of jetties on each side of the natural channel at such a distance apart that they should, by contracting the channel, quicken the current, and thus not only prevent the deposition of sediment, but should scour out the bottom and increase the depth. Each jetty was over two miles in length, and was constructed of tiers of woven willow mattresses sunk in position and loaded with stones, the surface above water level being protected with rough masonry. The interstices in the structure thus formed quickly filled with silt, and became practically imperishable.

The sum agreed to be paid for the work was $5,250,000, of which $500,000 was to be paid after a channel 20 feet deep by 200 feet in width had been secured, another $500,000 after a channel 22 feet deep, and other sums on the obtaining of channels 26 and 28 feet deep respectively. But as a guarantee that the maintenance of the channel should not cost more than $100,000 a year, the final $1,000,000 of the whole sum was to be withheld until a channel of 30 feet maximum depth had been kept throughout during twenty years. Congress, however, deeming these terms unnecessarily severe, with remarkable unanimity voted to pay him $1,750,000 in advance of his contract terms after he had secured 22 feet depth. On July 8, 1879, four years after he began work on the jetties, the United States inspecting officer reported that the maximum depth of 30 feet had been secured and that the least width of the 26 foot channel was 200 feet.

By this means New Orleans has been raised from being the eleventh to the second export city of the United States. The current of the river has maintained the maximum depth ever since, and the entire cost of the jetties was one-half of the estimated cost of the proposed canal.

Meanwhile Mr. Eads outlined one of the most magnificent plans which hydraulic engineering has ever undertaken. He proposed to extend deep water from the Gulf of Mexico to the mouth of the Ohio River, into the very heart of the Mississippi River valley, by permanently locating the channel, and so putting an end to the caving of its banks. According to his belief, "the establishment of a uniformity of width would produce a uniformity of depth, and secure at least 20 feet at low water from Cairo to the Gulf. Uniformity of width and depth would insure uniformity of current and a uniform charge of suspended sediment, and this would virtually stop the caving of banks, for these are caused by changes in current velocity."

In 1879 Congress authorized the creation of a mixed commission of civil and military engineers, called the Mississippi River Commission, to consist of seven members, of which Mr. Eads was one. Its duty was to prepare plans for the improvement of the navigation of the river and to prevent destructive floods. A report adopting the jetty system was made, in which Mr. Eads' views were fully indorsed. Appropriations were made by Congress, and two reaches of the Mississippi—Plum Point, 20 miles long, and Lake Providence, 35 miles long—were selected for improvement. The low water depth of the former was only 5 feet, while the latter, 400 miles further down the river, had a depth of nearly 6 feet. Permeable contraction works, similar to those used at the South Pass, were put in position for one season in the period between two floods, and the effect produced by the works during the first flood that followed was simply marvelous. The depth was increased through the upper reach to 12 feet at low water, and through the lower reach to 15 feet, and scores of millions of cubic yards of sediment were deposited behind the permeable works, through the checking of the current. New shore lines of an approximate uniform width were developed, but later Congresses refused to continue sufficient appropriations, although enough had been accomplished to show the entire practicability of the plan.

In 1878 Mr. Eads made an elaborate report upon the improvement of the mouth of the St. Johns River, Florida, in response to a request of the merchants and authorities and citizens of Jacksonville; and in 1880, at the request of the Governor of California, he visited the Sacramento River and reported upon plans for the preservation of its channel and the arrest of debris from the mines. He was asked by the Minister of Public Works of Canada, in 1881, to examine the harbor of Toronto, and subsequently submitted a report upon the measures required for its improvement. In 1882 he was commissioned by the Mexican government to examine the port of Vera Cruz, and to suggest means of rendering the entrance safe, and to protect shipping inside. His suggestions were approved by the authorities, and movements inaugurated to construct the necessary works. He likewise reported upon the harbor of Tampico.

During his different visits to Europe he has inspected the mouths of nearly every river emptying into the Baltic Sea and the German Ocean. He has also examined the river courses of the Rhone, the Danube, including the works at their mouths, and the Theiss, in Hungary; also the Suez, Amsterdam, and Rhone ship canals. Early in 1884 he was requested by the authorities of Galveston, Texas, to undertake the improvement of their harbor and the entrance to it, but the execution of this work was deferred by legislation. In the meanwhile, on the occasion of the Parliamentary inquiry into the merits of the Manchester ship canal, Mr. Eads was retained by the Mersey Docks and Harbor Board, of Liverpool, England, at a fee of £3,500, said to be the largest ever yet paid to an engineer. His evidence caused the rejection of the scheme as it then stood; and the modification by which the canal was laid out along the shore of the wide part of the Mersey, instead of being led in a trained channel through the sandy flats, was due to his advice. He was also personally consulted by the Emperor of Brazil concerning the harbors of his kingdom.

The last great enterprise to which Mr. Eads devoted his attention, and which he still leaves incompleted, was the ship railway across the isthmus of Tehuantepec, Mexico. As early as 1879, Mr. Eads determined upon this as a more promising undertaking than the Panama or Nicaragua canals. The length of the route is 134 miles, its highest point 726 feet above the level of the sea, and its heaviest grade less than 53 feet a mile. He proposed the construction of a many-tracked railroad, with turntables and other necessary appliances, and with dry docks at each end. The largest ocean steamers, heavily laden, were to be docked, placed in huge cradles, mounted on cars, and dragged overland from sea to sea by the combined force of half a dozen giant locomotives. This, he contended, was entirely practicable, because the railway can be built wherever the canal can, at one-half the cost of the canal with locks, or one-quarter the cost of one at tide level, because it can be built in one-third or one-quarter the time needed to build a canal; because more vessels can be carried in a day over the railway than through the canal; because four or five times the speed practicable on a canal can be secured; because the capacity of the railway can be increased to suit increased needs without disturbance; because it will cost less to maintain and operate it than it will to operate and maintain a canal; because it can be built and operated where the canal cannot be; because more accurate estimates can be made of the cost and time needed for its construction; and because its location is the very best of all those which are proposed on the American isthmus.

The entire cost of this stupendous work was estimated by Mr. Eads at less than $75,000,000, and he claimed that the tonnage that might naturally be expected to follow this route would pay handsome profits on the investment. A valuable concession was made by the Mexican government for the building of this road, and for several years he endeavored to persuade the United States government to undertake the building of this ship railway, but finally gave it up, and formed a private company for its construction. A bill to incorporate this company passed the United States Senate during the session of 1886–7, but failed in the House of Representatives.

In 1872 he was elected president of the St. Louis Academy of Sciences, and filled that office for two terms, delivering valuable scientific addresses when he was inaugurated. During the same year, he received an election to membership in the National Academy of Sciences. In 1881 he made an extemporary address before the British Association for the Advancement of Science, of which he was a member, at York, on the improvement of the Mississippi, also on the Tehuantepec ship railway, which were by unanimous consent ordered to be embodied in its report of the proceedings. Mr. Eads received in June, 1884, the Albert medal of the British Society of Arts, awarded to "the distinguished American engineer, whose works have been of such great service in improving the water communication of North America, and have thereby rendered valuable aid to the commerce of the world." He also received the honorary degree of LL.D. from the State University of Missouri.

Mr. Eads was a Fellow of the American Association for the Advancement of Science, a member of the American Society of Civil Engineers, and a member of the Institute of Civil Engineers of Great Britain.

His writings and professional papers appeared variously, but the most important have been collected and published as the "Addresses and Papers of James B. Eads, together with a Biographical Sketch." (St. Louis, 1884.)

The winter of 1886–7 was spent between New York and Washington, and his time devoted almost entirely to pushing the interests of the ship railway. Soon after the introduction of the bill for its incorporation in Congress, Mr. Eads went in failing health to Nassau, New Providence, Bahama Islands, where, on March 8, 1887, he died after a brief illness.

It is said of De Soto, whose remains were consigned to the waters of the great Mississippi at midnight, while the first requiems ever chanted over its surface were sung, that he came to seek a fortune and found nothing better than a tomb. Eads gained his fortune by conquering the river, and the mighty structures resulting from his genius will remain in perpetuation of his memory so long as engineering skill shall have a record in the world's history. M. B.

A correspondent says: A fortune awaits the inventor of a successful perfect dash or buggy lamp, or a lamp to be attached to a horse's breast. One that will not go out when most needed, and with sufficiently strong reflector to light the road for some distance ahead of the horse.

Tram Cars for South America.

The J. G. Brill Company, of Philadelphia, have received from South America probably the largest order for tram cars ever placed at one time. It is certainly a curious collection.

The entire order for cars consists of 352, all of which are 16 feet body. They are to run on a tram road of about 100 miles in length, and to be drawn by horses.

Some of them are sleeping cars, and one can easily imagine the expression that would flit over the average New Yorker's face at the thought of a hundred mile ride in a sleeping car with horse flesh as the means of propulsion.

The road connects a large number of small towns and cities, and is to be run over the surface of the country in the same way as we would run an ordinary street railway in our own cities. They will take on passengers and freight along the route, same as an ordinary steam road. Your readers would naturally ask here, Why build a tram road, to be run with horses, a hundred miles in length? But when I add that the country through which the road passes is a poor one, and that coal is $11 per ton and the average horse only $20 per head, they will easily see that this kind of a road will be more economical than steam.

The equipment comprises almost every kind of a car used by our steam roads. They are as follows:

Eighty combination first and second class cars. These cars have a partition through the center, dividing them into two apartments, for first and second class passengers. They are arranged to carry baggage on the roof, and have an iron ladder on one side.

Four sleeping cars. These are fitted with two double berths on either side, that is, upper and lower berths, arranged in about the regulation style of sleeping cars in this country, and are fitted with lavatory, water closet, and stoves.

Four double decked open cars. These have seven seats, each with reversible backs, and a circular stairway at each end, and top seats, with a seating capacity of 57 passengers for each car.

Twenty platform cars. All of these are the four-wheeled cars.

Twenty gondola cars. These are cars with drop sides.

Six refrigerator cars. These are built on exactly the same principle as the regular refrigerator car used for carrying dressed beef in this country.

Four chicken or poultry cars, built after the style of stock cars, with a series of coops inside.

Eight cattle cars, arranged like the ordinary cattle car of this country.

Four universal dump cars.

Two derrick cars for the lifting of heavy material on and off cars.

Two hundred box cars, like the ordinary box car, with a door on either side.—*Street Railway Journal.*

Final Test of the 110 Ton Gun.

The final proof experiment with the first of the great guns for Her Majesty's ship Benbow took place at the Woolwich Arsenal butts recently. The loading of the gun, which will be performed on board ship by hydraulics, had to be carried out by hand, and was a difficult and tedious process, but at length the proof shot, weighing 1,800 pounds, was driven forward of the powder chamber, and eight octagonal cartridges were packed in behind it, each weighing 125 pounds, or an aggregate of exactly 1,000 pounds. The powder was of a slow burning description, technically known as "S. B. L." Most of the preceding rounds have been fired with Westphalian brown powder, and the velocities have varied with the weight of charge from 1,699 feet per second, with a pressure 9·65 tons, to 2,078 feet with 18·7 tons pressure. On the gun being fired it was found that the shot had achieved an initial velocity of 2,128 feet per second, with the remarkably low pressure of 16·1 tons. This velocity is equal to a rate of over 24 miles per minute or over 1,400 miles per hour. A second round was fired with precisely similar results.

Wood and Iron thinks it is well to remember the following data in relation to the strength of material:

The strength of shafts, for either bending or twisting, varies as the cube of the diameter. Thus a 2 inch shaft is eight times as strong as a 1 inch shaft.

A 1 inch shaft, running 100 revolutions per minute, will transmit 1 H. P. A 1 inch shaft will safely stand the force of 50 pounds at the end of a crank 1 foot long.

The power that a belt can transmit varies directly as its width and speed, with the limit of 5,000 or 6,000 feet per minute.

A 1 inch belt running 800 feet per minute will transmit 1 H. P.

The strength of gear teeth varies as the width of the face and the square of the pitch. A gear of 1 inch pitch and 1 inch face will stand a strain of 500 pounds.

The tensile strength of wrought iron rods varies as the square of the diameter. A 1 inch rod will support 7,000 pounds, and a 2 inch rod four times as much.