

MEMOIR
OF
JAMES BUCHANAN EADS.
1820-1887.

BY
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MEMOIR OF JAMES BUCHANAN EADS.

JAMES B. EADS was born at Lawrenceburgh, Indiana, May 23rd, 1820, at which place his father, Thomas C. Eads, was engaged in mercantile business. A few years after young Eads' birth his father, having met with reverses in Lawrenceburgh, removed with his family to Louisville, Kentucky, and soon afterwards to St. Louis. At this time the family consisted of Thomas C. Eads, his wife, son, and two daughters. The steamboat on which they took passage to St. Louis was burned, their household goods were all destroyed, and young Eads, then about 13 years of age, found himself in St. Louis under the immediate necessity of finding something to do to assist in the support of the family, and this first employment was peddling apples from a basket. In this capacity he doubtless attracted the attention of Mr. Williams, of the mercantile house of Williams and Durings, for with this firm he was soon employed as a clerk. The senior member, impressed with his ability, invited him to use his library, and the lad, who had been obliged to leave school at twelve years of age, was thus enabled to resume his studies to such purpose that, although he never after attended school in later life, his varied acquirements were recognized as large, even among men wholly devoted to science or letters.

His next employment was that of purser on a steamboat on the Mississippi river, in which position he not only had the opportunity to use the mercantile knowledge that he had previously acquired, but also to recognize the urgent necessity for saving the wrecks of boats abandoned along the river. Other men had long before the same opportunity, but Eads alone perceived its importance. He first devised a diving bell for recovering cargoes, and, succeeding in this, he fitted out a large vessel with appliances for lifting the entire hull with its cargo, and formed a company for carrying on wrecking operations over the whole river and its tributaries. He was very successful in this business, but it required him to be moving about nearly all of his time. He was engaged to be married and desired a home, so that in 1845 he sold out his interest and engaged in the manufacture of glass in St. Louis. Within three years this proved to be a disastrous failure, in which was swept away all of his

fortune, and worse than all, it left him \$25,000 in debt, with a young family dependent upon him. He now resumed his former business upon a capital of \$1,500, borrowed from his creditors. In this he was again eminently successful, so that soon he had paid off all his creditors in full, and in 1855-'6 he made his first proposition to the General Government to contract to remove from the Mississippi river snags and other obstructions to navigation and to keep the channel free and open for a term of years. The bill passed the House of Representatives, but the Senate failed to take action. The proposition itself is evidence of Mr. Eads' bold and enterprising spirit and far-seeing sagacity. In the business in which he was now engaged his opportunities for studying the river were great and were not lost upon him. The laws which governed its flow and determined its deposits were studied with such care and precision that when later the opportunity came for their application he was found fully equipped for the solution of the problem. His success in the management of a large enterprise had given him reputation at home, which was soon to be greatly extended, for almost immediately after the surrender of Fort Sumter he was summoned to Washington to give his views upon the best methods of utilizing our Western waters for attack and defense; these he gave in a written statement, advising the use of gun-boats propelled by steam and of peculiar construction, the casemates slanting back at an angle of 35 degrees from the water line, armor-plated, and extending entirely around the vessel, forming a rectangular gun deck. The Quartermaster General advertised for bids and Mr. Eads' proposal was accepted. The contract was executed August 7th, 1861, by which Mr. Eads bound himself to construct seven of these vessels, having a capacity of about 600 tons each, and to be ready for armament in sixty-five days. None but a bold and self-reliant man would have ventured to make such a contract. The manufactories of the country were paralyzed, workmen were scattered and enlisting in the Army, and it seemed hopeless to expect the completion of the work even approximately to the time specified. The result is graphically described by Boynton in his "History of the Navy during the Rebellion," Vol. 1, pp. 502-504:

"The signatures were scarcely dry upon this important contract before persons in different parts of the country were employed upon the work through telegraphic orders issued from Washington. Special agents were dispatched in every direction, and saw-mills

were simultaneously occupied in cutting the timber required in the construction of the vessels in Kentucky, Tennessee, Illinois, Indiana, Ohio, Minnesota, and Missouri, and railroads, steamboats, and barges were engaged for its immediate transportation. Nearly all of the largest machine shops and foundries in St. Louis, and many small ones, were at once set at work day and night, and the telegraph lines between St. Louis and Pittsburgh and Cincinnati were occupied frequently for hours in transmitting instructions to similar establishments in those cities for the construction of the twenty-one steam-engines and the five and thirty steam-boilers that were to propel the fleet. The large rolling mills of Gaylord, Sons & Co., at Portsmouth, Ohio; those of Swift & Co., at Newport, Ky.; and of Harrison, Chouteau & Valle, at St. Louis, were all employed in rolling armor plate. Mr. Thomas G. Gaylord, of Cincinnati, undertook to furnish this important material, and his promptness and energy greatly contributed to the rapid progress of the work. To him justly belongs the credit of rolling the first iron plating used in the war. Within two weeks not less than four thousand men were engaged in the various details of its construction. Neither the sanctity of the Sabbath nor the darkness of night were permitted to interrupt it. The workmen on the hulls were promised a handsome bonus in money for each one who stood steadfastly at the work until it was completed, and many thousands of dollars were thus gratuitously paid by Mr. Eads when it was finished. On the 12th of October, 1861, the first United States iron-clad, with her boilers and engines on board, was launched in Carondelet, Mo., in forty-five days from the laying of her keel. She was named the St. Louis by Rear Admiral Foote, in honor of the city. In ten days after the Carondelet was launched, and the Cincinnati, Louisville, Mound City, Cairo, and Pittsburgh followed in rapid succession. An eighth vessel, larger, more powerful, and superior in every respect, was also undertaken before the hulls of the first seven had fairly assumed shape. Thus one individual put in construction and pushed to completion within one hundred days a powerful squadron of eight steamers, aggregating five thousand tons, capable of steaming at nine knots per hour, each heavily armored, 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."

Mr. Eads constructed in all fourteen heavily armored gun-boats

and converted seven transports into what were called "tin-clads" or musket-proof gun-boats, and he built in addition four heavy mortar boats.

His professional career cannot be more fittingly described than by the following from the proceedings of the Am. Soc. of C. E. :

"His next work was the construction of the arched bridge over the Mississippi river at St. Louis, with whose history and plans most of the older members of the Society are familiar; hence only its principal features will be described. Since its construction, in the years 1867-'74, many important bridges have been built and deep foundations sunken, but at the time the work was commenced on this bridge there were no well-known precedents for some of its principal features or dimensions. The sudden changes in the river bed at this point made it necessary to go to the bed-rock for the foundation of the piers. The base of one pier is 136 feet below high water, and it was sunken through 90 feet of sand and gravel; another is 130 feet below high water, and it went through 80 feet of sand.

"The piers are massive structures, one of them weighing 45,000 tons. The central span is 520 feet in the clear, and the two side spans 502 feet. The plan of the superstructure is a ribbed arch carrying a double track railway with a broad wagon-way above.

"By the requirements of the act of Congress the clear height was fixed at 50 feet above the city directrix.

"To show how doubtful was considered the practicability of erecting spans of the length required the following extract is given from the resolutions adopted by a convention composed of twenty-eight of the leading civil engineers of the United States, and whose names were appended to the report of the convention :

"*Resolved*, That we as practical engineers cannot conscientiously recommend to the parties in interest to venture upon the construction of spans of as great length as the maximum one prescribed by law' (500 feet).

"Mr. Eads, however, so clearly proved the correctness of his plans and showed that engineers of international reputation had designed even longer spans, which had been approved by their brother engineers, and that there were in existence at the time bridges whose spans were nearly equal to his proposed plans, that the Bridge Company were fully satisfied with his designs, and he proceeded with the construction of the work.

"The years spent in this great enterprise were fraught with care, anxieties, and constant labor.

"No one can read his masterly reports upon this bridge without being deeply impressed, not only with his intimate knowledge of the details of the work, but with the fact that he designed nearly all of them himself. The conditions were so extraordinary in many respects that it required a master mind, a real mechanical genius, to devise and invent many appliances, particularly for the deep foundation work. The 'Eads sand pump,' a model of which is in the possession of the society, although very simple, was a novel device, and utilized forces in such a way as to greatly facilitate the removal of the material from under the caissons. Many of the peculiar arrangements of the air locks were devised by Mr. Eads for that bridge, and some of them were afterwards used in sinking the piers of the Brooklyn bridge.

"In 1881 the historian of the St. Louis bridge, Professor C. M. Woodward, Assoc. Am. Soc. C. E., of Washington University, paid the following well-deserved tribute to the engineering of the east abutment of the bridge: 'The construction of the east abutment was a signal triumph of engineering. It was quite unparalleled, both in size and in the depth to which it was sunk, and it stands to-day the deepest subaqueous foundation ever built.'

"As to the superstructure, it marked an era in bridge-building, and particularly in the character of materials. The obstacles met with in the manufacture of steel to meet the requirements of spans of this kind and length were serious and many. The steel-makers found that their facilities were inadequate to the magnitude of the work they had undertaken; they had no workmen of sufficient skill, and their foreman had never worked steel in such large masses. The rigid tests, both for maximum strength and for elastic limit, were new, and the character of the workmanship was quite exceptional.

"Speaking himself of the bridge, and of the various unforeseen expenses and difficulties that had attended its construction, Mr. Eads, in his report to the Bridge Company in 1871, closes as follows:

"When all of the many difficulties that have retarded this great work shall have at last been surmounted and the bridge becomes an accomplished fact, it will be found unequalled in the important qualities of strength, durability, capacity, and magnitude by any

similar structure in the world. Its great usefulness, undoubted safety, and beautiful proportions will constitute it a national bridge, entitling those through whose individual wealth it has been created to the respect of their fellow-men, while its imperishable construction will convey to future ages a noble record of the enterprise and intelligence which mark the present times.'

"The magnitude of the work may be appreciated from the following summary of its dimensions, quantities, and weights:

"Length of the piers at base, about 85 feet; width, about 60 feet; length at top, about 63 feet; width, about 24 feet.

"Height from bed-rock to top of masonry: greatest, 192 feet 9 inches; least, 112 feet 8½ inches.

"Foundations below low water: greatest depth, 94 feet; least depth, 13 feet; below high water: greatest, 135 feet 7 inches; least, 54 feet 7 inches.

"Total amount of masonry and concrete, 102,897.6 cubic yards.

"Total weight of steel, iron, wood, and tracks, 13,135,500 pounds.

"The following, from London 'Engineering,' written just before the completion of the bridge, will show the appreciation by the engineering profession in England of the magnitude of the work and of the great qualities demanded for its success:

"Our present requirement being to select some example of the most highly developed type of bridge-building of the present day, we have no difficulty in passing before ourselves in mental review the different works now in progress throughout the world, and we have still less difficulty in selecting as our example the magnificent arched bridge now almost completed by Captain Eads at St. Louis. In that work the alliance between the theorist and the practical man is complete. The highest powers of modern analysis have been called into requisition for the determination of the strains; the resources of the manufacturer have been taxed to the utmost in production of material and perfection of workmanship, and the ingenuity of the builder has been alike taxed to put the unprecedented mass into place. In short, brain power has been called into action in every department. One long-sighed-for result, the welding of the theoretical and practical man into one homogeneous mass, without which no truly great undertaking could possibly be carried out, has at last been attained.'

"The St. Louis bridge was scarcely completed when Mr. Eads turned his attention practically to a subject that had long been in

his mind and desires, since his proposition to the Government in 1856 to open up and maintain the channels of the rivers, and that was the opening of the mouth of the Mississippi river, where the sand bars lying at the embouchure of the passes into the Gulf had become a very serious obstruction to the commerce between the Mississippi Valley and the ocean.

"In February, 1874, he made a formal proposition to Congress to open the mouth of the Southwest Pass and maintain the channel. This he agreed to do at the sole risk of himself and associates. The attacks upon his proposition from all sides and the gallant and victorious fight which he waged single-handed, in Congress and out of it, have already become a part of the history of this important work and need not be repeated here. The valor, fortitude, and persistence of Mr. Eads in these controversies only showed his natural traits of character and revealed an adversary in polemic discussion that few cared to meet. His papers, addresses, and communications to Congress and to the magazines and newspapers during the preliminary stages and the construction of this work are probably unsurpassed in value as engineering expositions of the principles controlling the flow of water, the movement and deposition of sediment, and of the correct methods of river improvements. The principal opposition to his proposal came from those army engineers who had proposed to solve the problem by building a canal from Fort St. Philip, on the main river above the head of the passes, to the adjacent sound. After considerable discussion a commission of engineers, composed of three army engineers, three civil engineers, and a member of the United States Coast Survey, was authorized by Congress.

"At the next session of Congress this commission, after personally examining certain important rivers of Europe which had been improved by jetties, reported in favor of the plan proposed by Mr. Eads, and recommended its application to the South Pass, the smallest of the three, where the depth on the bar was about eight feet, in place of the Southwest Pass, selected by Mr. Eads, where the depth was over twelve feet.

"The work was commenced in the summer of 1875, the construction of which required about four years, the channel demanded by the contract with the Government having been obtained in July, 1879. Its dimensions were a depth of 26 feet, with a width of 200

feet at that depth, and a central depth of 30 feet, without regard to width.

"Mr. Eads brought to the construction of this important work the same genius that had characterized his management of the St. Louis bridge. No obstacle, whether of an engineering or financial character, dismayed or even discouraged him. His great qualities were exhibited on this work in a marked degree. His knowledge of the laws of currents, his predictions of complete success by working in accordance with these laws, his unalterable determination to achieve success, and his unfaltering faith in the darkest hours of that work were indelibly impressed upon the minds of his intimate associates, so that, whatever his detractors said, those who knew him best felt the inspiration of his great genius, a confidence in his consummate skill, and a repose in his unswerving confidence in the final result.

"The following words from an address delivered at St. Louis immediately after the passage of the jetty act show the high purpose and the implicit faith of Mr. Eads. He rested calmly in the operation of laws which he knew from practical experience and careful study were controlling the forces with which he was dealing:

"If the profession of an engineer were not based upon exact science I might tremble for the result, in view of the immensity of the interests which are dependent upon my success. But every atom that moves onward in the river, from the moment it leaves its home amid crystal springs or mountain snows, throughout the 1,500 leagues of its devious pathway, until it is finally lost in the vast waters of the Gulf, is controlled by laws as fixed and certain as those which direct the majestic march of the heavenly spheres. Every phenomenon and apparent eccentricity of the river, its scouring and depositing action, its caving banks, the formation of the bars at its mouth, the effect of the waves and tides of the sea upon its currents and deposits, are controlled by laws as immutable as the Creator, and the engineer needs only to be assured that he does not ignore the existence of any of these laws to feel positively certain of the result he aims at.

"I therefore undertake the work with a faith based upon the ever-constant ordinance of God himself; and so certain as He will spare my life and faculties for two years more I will give to the Mississippi river, through His grace and by the application of His laws, a deep, open, safe, and permanent outlet to the sea."

"The jetties which Mr. Eads designed and built extend from the land's end at the mouth of South Pass about two and a quarter miles out over the bar and into deep water in the Gulf. The jetties are parallel, and the channel between them is about seven hundred feet wide. They are built of willow mattresses sunken by stone and capped near the sea ends with massive concrete blocks, the largest of which weigh 265 tons, and were, at the time they were put in position, the largest blocks ever placed on sea walls.

"The works at the head of the passes required skillful designing, for the conditions there were very complicated. By employing permeable constructions deposits were induced and the river compelled to excavate, by its accelerated current, a channel through the bar which had obstructed the entrance to South Pass and on which there were but 15 feet of water.

"As at the jetties, so at the head of the passes, the works have simply assisted nature in opening channels and in building banks.

"When we contemplate the fact that these works are composed almost wholly of light willows, with a large portion of the mattresses standing on edge, simply as screens to check the current and cause deposit, they constitute a remarkable illustration of how completely the immense forces of nature may sometimes be controlled by a wise use of the most inexpensive and unsubstantial materials, which nature seemingly places within convenient reach of man for the very purpose.

"Here by the gentlest influences the mighty current is swayed and directed completely obedient to his will. There is no instance indeed in the world where such a vast volume of water is placed under such absolute and permanent control of the engineer through methods so economic and simple as those adopted at the head of the passes of the Mississippi river.

"The character of this work, its great importance to the commercial interests of the country and the world, its successful accomplishment, the continued maintenance of the deep and wide channel which the work created, the difficult engineering problems which were solved so successfully, all conspired to place Mr. Eads in the foremost rank of hydraulic engineers, as his great bridge had already placed him in the front rank of bridge engineers.

"The unselfish patriotism and desire to promote the welfare of his country are seen in nothing in his life more than in his persistent efforts to secure the improvement of the Mississippi river from the

Gulf to the mouth of the Ohio. Some of the most laborious years of his life were spent in efforts to obtain the legislation from Congress necessary to inaugurate a comprehensive system of river improvement under a mixed commission. It is not enough to say that he did more than any one to accomplish this; it is only the truth to say that without his untiring efforts neither the commission nor the improvement works would have existed.

"In the clearest and most convincing manner he stated the plan of improvement in documents addressed to Congress and in addresses before public meetings in the Mississippi Valley. Between 1874 and 1879 he outlined one of the most magnificent and comprehensive plans which hydraulic engineers ever undertook in this or any other country. By untiring efforts he at last brought about a public sentiment in favor of the improvement and obtained the necessary Congressional action.

"The commission was appointed in 1879 and presented its preliminary report February 17th, 1880. He was appointed on this commission and served two years, when his failing health and the cares of other important business compelled him to resign and go abroad. He, however, to the time of his death, was most deeply interested in this great work, and deplored what he believed to be the departure of the commission from the true principles of the improvement, and combatted false methods with all the strength of his great intellect. This is no place to indulge in controversial discussions, but it is only a duty to Mr. Eads to make a brief statement of the views and plans for whose adoption, execution, and preservation he had been for several years such an earnest and untiring advocate.

"The improvement of the great river and the welfare of the great valley were among the most cherished objects of his life, and he could not brook any departure from the correct principles, even though it was counseled by his best friends. As far as this important question was concerned, they were his enemies who opposed its correct treatment, and he mercilessly fought them in order that he might bring about the adoption of correct plans in place of what he believed to be incorrect ones. This intense earnestness in the discussion of this, to him, vital question often made him appear a bitter and unrelenting foe to his opponents, but no man ever lived with a kinder heart than he, even towards those who opposed him. To him the unfolding of great and correct principles was more than

personal friendships. His beliefs were his friends if they held within their grasp and scope the weal of humanity.

"The following extracts are from his 'Minority Report of Mississippi River Commission, April, 1882:'

"I have named three controlling principles which are present in every problem presented by the characteristic phenomena of the river. Each one of these is very simple in itself. It is, however, absolutely necessary to remember each of them to fully comprehend the subject and to be able to recognize the respective influence of each in creating these phenomena. I will briefly repeat them to more strongly impress their importance: The first is the force producing the current. This force is simply the result of the fall of the river from a higher to a lower level. The second is the frictional resistance of its bed. The third is the intimate relation between the quantity of sediment carried in the water and the velocity of the current. If we increase or decrease the current from any cause we increase or decrease the quantity of sediment carried by the river. We can increase or decrease the current temporarily by either of two methods, namely, by altering the slope or by altering the frictional resistance. Therefore by these two methods the scouring and depositing effect can be produced. If we increase the current during the floods we produce a greater deepening and enlarging of the channel through the shoals, and they are left in better condition during low water, and at the same time we ultimately lower the height of the flood. If we decrease the current we produce shoals and higher floods.'

"He constantly and persistently held that the 'jetty' principle, which the Commission originally adopted, should not be departed from; that the contraction of the channel by permeable works to its normal width of about 3,000 feet would accomplish the desired result, which would be not only a deepening of the channel for navigation, but a restoration of the bed of the river to an approximately uniform plane in place of the strikingly irregular bed, with its deep holes and uplifting bars, which were due entirely to the varying widths of the river in its unrectified condition, and that therefore it was utterly useless to waste money in impracticable attempts to hold the caving concave banks of the river by costly revetments, which, he contended, had already swallowed up millions of public money without any useful result to show for it.

"From the first he contended that the proper improvement of

the river by deepening the channel would decrease the frictional resistance to the current by lessening the surface exposed to it; that then the flood volume would flow on lower slopes; that the practical result would be the lowering of these floods; that the necessity for high levees would no longer exist, and that the 30,000 square miles of rich alluvial lands, now subject to inundation, would be effectually reclaimed by the same works that produced and maintained a deep channel from Cairo to New Orleans.

"In all the years during which he worked and fought for this grand result he had no selfish interest to subserve, no contract to execute, nothing himself to gain, and he had no thought even of the fame that would come to him as a crown of his unremitting efforts, for wealth he had already, and fame was not wanting.

"The channel at the mouth of the Mississippi river was obtained in July, 1879. The Panama Canal Congress was held in May of the same year.

"The attention of the civilized world was directed as never before to an interoceanic transit-way. Mr. Eads conceived the idea of extending the Mississippi river, commercially speaking, into the Pacific Ocean, and of opening up to the eastern coast of Mexico and the States bordering on the Gulf and to the great valley of the Mississippi the rich markets of the Pacific, and at the same time to connect the Atlantic and Pacific coasts of the United States by the shortest possible route by way of the Tehuantepec Isthmus, where a crossing for ships would effect a saving of 2,000 miles over the Panama route and 1,500 miles over the Nicaragua route. As a canal was impracticable at Tehuantepec he proposed to build a ship railway for the transportation of ocean vessels over the 140 miles of land that separate the Gulf of Mexico from the Pacific Ocean. He at once began the preliminary plans for the work and made a careful study of the subject in the fall and winter of 1879.

"On March 9th and 13th, 1880, he appeared before the Select Committee of the House of Representatives on Interoceanic Canals and replied to Count De Lesseps, who was advocating the construction of the Panama Canal. In his remarks Mr. Eads explained in considerable detail his plans for a ship railway and contended that it was entirely practicable. On August 11th, 1880, he delivered an address before the San Francisco Chamber of Commerce on the 'Interoceanic Ship Railway,' in which he said:

"Standing in your presence to-day and conscious of the full im-

port of my words, I declare to you, *first*, that a ship railway can be constructed at one-half the cost of a canal with locks, and in one-half the time; *second*, that when completed the railway can be maintained and operated at a cost not exceeding that of a canal; *third*, that your largest vessels with their cargoes can be safely carried from ocean to ocean in one-half the time required for a passage through the canal.' And he then gave additional reasons for his preference for a railway.

"In November, 1880, he went to Mexico and obtained a valuable concession from the Mexican Government for building a ship railway. He instituted the preliminary surveys by the assistance of that Government and went with the engineering party to the Isthmus on board a Mexican Government vessel which had been placed at his disposal.

"In March, 1881, he presented his views on this subject in the North American Review and explained and enforced the controlling principles at considerable length.

"In the winter of 1881 he made a proposition to Congress to build the railway at his own expense and at his own risk, provided the Government would guarantee a dividend of 6 per cent. for fifteen years after he had, by the actual construction and operation of the railway, proven its practicability. His views of the feasibility of the railway were supported by the professional opinions of a large number of practical experts both in the United States and England, and the Senate and House committees favorably reported the bill, but the Senate failed to take action upon it.

"In 1885 Mr. Eads obtained a modification of the concession from Mexico by which that Government guaranteed that one-third of the net revenue should amount to one million two hundred and fifty thousand dollars (\$1,250,000) per annum, and granted several other important changes which increased the value of the concession.

"He then introduced a new bill in Congress, by which, when the ship railway should be entirely completed and put into operation, transporting large ocean vessels, fully laden, the Government guaranteed that two-thirds of the net revenue should amount to two million five hundred thousand dollars (\$2,500,000), Mexico having guaranteed the other third.

"This bill was favorably reported by the committee of the two Houses before the end of that session, but in the last session of Congress it was deemed advisable to exclude all guarantee clauses and

ask for a simple charter. Mr. Eads went to Washington this last winter—in January—although in very poor health, to secure the passage of the act, confidently believing that it would insure the raising of the capital, in this country and England, necessary to build the railway. He was not able to remain in Washington, and, by the advice of his physician and friends, sailed for Nassau, N. P., Bahamas, where he died after a short illness. After his arrival at Nassau his health rapidly improved, but he contracted a slight cold, which resulted in congestion of the lungs. This was the remote cause of his death, but the direct cause was uræmia, from which he had been a great sufferer for several years.

“During these years and until his death Mr. Eads not only advocated the important project of a ship railway, but devoted much of his time and attention to the preliminary work necessary to place the enterprise squarely and fully before the world. He did not hesitate to support his opinions with his money, and although he had associated with himself about ninety promoters, all financially interested in the work, he went far beyond any of them in furnishing the necessary funds for making elaborate surveys, plans, and a model illustrating them and in meeting the expenses incident to so great a work. His views, advanced by himself and those associated with him and sent to all parts of the civilized world, have gained a firm foothold in the belief of thinking men everywhere.

“His last engineering work, while sick at Nassau, was the examination and review of the plans for an improved hydraulic lift for the ship railway, which he had placed in the hands of a mechanical engineer before he left this country.

“He exhibited in his last hours the same heroic courage and sublime faith that characterized his entire life. He was not afraid to die, but such was his devotion to the great enterprise in which he was engaged, so strong was his presentiment that he would live to see the fruition of his hopes, that he could not think of leaving the world until his work was done and he should see with his own eyes what the great poet saw in vision :

“‘Lo, ships from seas by nature barred
Mount along ways by man prepared,
Along far-stretching vales, whose streams
Seek other seas ; their canvas gleams
And busy towns grow up on coasts
Thronged yesterday by airy ghosts.’

"The pure motives which actuated Mr. Eads in this great project and the lofty purpose that led him to devote his life and bend all his energies to its accomplishment can be clearly read between the lines of the following extract from his address before the Boston Society of Arts May 19th, 1885:

"When this work is completed, as I am sure it will be, and that long before a canal is cut across the American isthmus, the benefits will be felt by our fellow-men all over the world, not only in lessening the cost of transportation on the necessities and luxuries of life and in shortening the long, weary, trackless distances which now separate nations from each other and by opening new markets for the multitude of commodities which are interchanged by the various peoples of the earth, but also by bringing distant communities into more social and commercial relation with each other, whereby the better sympathies and sentiments of each will be promoted, their prejudices removed, the amenities of life increased, and the benefits of civilization, science, and religion more surely tend to the increase of 'peace on earth, good will to men.' This work, when finished, will be the realization of the ardent wish of statesmen and philanthropists everywhere, the dream of kings and conquerors during the last three hundred and fifty years, and a fitting supplement to the grand achievements which have marked the progress of the nineteenth century.'

"The principal engineering works of Mr. Eads have now been very briefly sketched. To speak of them at any length would require too much space, although much more that is instructive and delineatory of Mr. Eads' character could profitably be stated.

"In addition to these more important undertakings, he examined and reported upon many engineering projects.

"In March, 1878, at the request of the city council of Jacksonville, Florida, he made a report upon the practicability of deepening the channel through the bar at the mouth of the St. John's river.

"After the construction of the South Pass jetties he was requested by the people of Galveston, Texas, to formulate a plan and take a contract from the United States Government to improve that harbor. He gave long and careful attention to the project, but Congress was not willing to grant a contract for the work.

"At the request of the Canadian Government he examined the harbor of Toronto and made plans for its improvement.

"At the solicitation of the Mexican Government he made surveys

and elaborate plans for the improvement of the harbors of Vera Cruz and Tampico.

"He examined into the problem of the drainage of the Sacramento river, as consulting engineer of the State of California.

"In 1884, by request of the Mersey Docks and Harbor Board of Liverpool, he appeared before a committee of the House of Lords and gave his testimony as to the effect of the terminal works of the Manchester ship canal upon the estuary of the Mersey and the bar at Liverpool. He brought to the solution of this question that same keen insight into hydraulics and the same close application that had made him so successful in this country. He showed so plainly the deleterious effects of the proposed plans that the committee decided against them. They have since been changed to conform to his suggestions.

"The Emperor of Brazil, Dom Pedro II, held Mr. Eads in high esteem, and made a special visit to the South Pass jetties when he was in this country. He afterwards offered Mr. Eads the position which was given, on his recommendation, to the lamented W. Milnor Roberts, past president Amer. Soc. C. E. About two years ago he was requested by the Brazilian Government to examine the mouth of the Rio Grande do Sul and make plans for its improvement, but ill health and pressing business prevented his acceptance of the offer.

"Mr. Eads traveled extensively in this and foreign countries and often in pursuit of information bearing upon the engineering enterprises which he had in hand.

"In 1877 Mr. Eads received a diploma from the University of the State of Missouri conferring upon him the honorary degree of LL. D.

"The letter of the president of the university, Hon. James S. Rollins, which accompanies the diploma, is worthy of being placed in this memoir, for it shows the appreciation in which Mr. Eads was held by those who knew him well in the State where the larger part of his life was spent: 'Allow me to say that this high honor has not been bestowed upon you as a matter of mere compliment to an eminent citizen of the State in which he resides, but on account of the high appreciation of your high position as a man of great scientific attainments and of the practical uses of this extensive knowledge in improving the facilities of commerce, developing the

internal resources of the country, and adding incalculably to its wealth and to the happiness and prosperity of its people.

“ ‘The bestowal of such honors and the recognition of your great services in accomplishing the noble ends at which you aim will be some remuneration to you for the sacrifices and labors which you have undergone in achieving such great advantages for our common country.’

“ In 1884 the Albert medal was awarded to Mr. Eads, he being the only American on whom this distinguished honor has been conferred.

“ The letter of the Secretary notifying Mr. Eads of the award is given following, as well as the resolutions of the Society :

“ ‘SOCIETY FOR THE ENCOURAGEMENT OF ART,

“ ‘MANUFACTURES, AND COMMERCE,

“ ‘JOHN STREET, ADELPHI, LONDON, W. C., *June 10th*, 1884.

“ ‘SIR: I am directed by the Council of this Society to inform you that they have had the pleasure of awarding to you the Society’s Albert medal as a token of their appreciation of the services you have rendered to the science of engineering.

“ ‘The medal was founded in 1862, in memory of His Royal Highness the Prince Consort and is awarded annually for distinguished merit in promoting arts, manufactures, or commerce.

“ ‘I may add that the award is made with the approval of His Royal Highness the Prince of Wales, the president of the Society, to whom it has been submitted. Should you be in England I have no doubt His Royal Highness would be pleased to present the medal to you himself, as he has done in previous cases, but should there be no opportunity for his doing so he will arrange for its transmission to you.

“ ‘I inclose for your information a list of the distinguished men of science to whom the medal has been given in previous years.

“ ‘I have the honor to be, sir, your obedient servant,

“ ‘H. T. WOOD,

“ ‘*Secretary.*

“ ‘James Buchanan Eads.’

“ ‘The following are the precise terms of the award :

“ ‘*Resolved*, That the Albert medal be awarded to Captain James Buchanan Eads, the distinguished American engineer, whose works have been of such great service in improving the water communica-

tions of North America, and have thereby rendered valuable aid to the commerce of the world.'

"Mr. Eads took just pride in this medal, for it had been conferred previously upon such distinguished men as Sir Rowland Hill, Napoleon III, Sir Joseph Whitworth, Ferdinand De Lesseps, Sir Henry Bessemer, Sir C. W. Siemens, Sir William Armstrong, Sir William Thompson, and several other illustrious persons.

"Mr. Eads was elected a member of the American Society of Civil Engineers December 16th, 1868, and a fellow March 30th 1870. He was vice-president from January 18th, 1882, to January 17th, 1883.

"He was elected a member of the Institution of Civil Engineers, Great Britain, May 4th, 1869, and fellow of the American Association for the Advancement of Science in 1879, and a member of the British Association in 1884. He was a member of the Society for Encouragement of Arts, Manufactures, and Commerce. He was also a member of the Engineers' Club of St. Louis and of the American Geographical Society. He was for two years president of the Academy of Science of St. Louis.

"The inventive genius of Mr. Eads is shown in the fact that nearly fifty patents were issued to him by the Governments of the United States and England for useful inventions in naval warfare, bridge foundations and superstructure, dredging-machines, navigation, river and harbor work, and ship-railway construction."

Mr. Eads was twice married. His first wife left him two daughters. His second wife was a widow with three daughters, and the combined families became as much one in love and accord as if the children had all been of the same parentage, and this fact speaks volumes for his lovable nature. He was a pleasant and forcible public speaker, but it was in private conversation that his persuasive eloquence, coupled with his mastery of the subject in hand, shone most conspicuously, and in this field he probably displayed greater ability than in devising the schemes which have given him a world-wide celebrity. He had a peculiar capacity, a sort of special instinct, for selecting the best men to aid him in the various departments of his great enterprises—men of special qualification for the parts assumed by them and of national reputation became his zealous coworkers—and he possessed this special characteristic of true greatness, that he never feared that praise of his associates might detract from his own fame. His views were broad, compre-

hending in their scope enterprises of the greatest magnitude with the minutest details which were necessary to their success. He perceived the need before the necessity had arisen, and so was prepared with the relief when the time for supplying it had come. Once that need was perceived, be it great or small, he gave it his careful consideration to determine the value of its accomplishment and, being satisfied that the end was worth more than the cost of the attainment, he bent all of his energies to the work with a courage that knew not failure; hence it was that, although some of his projects were of the most stupendous character, he had so weighed their value and demonstrated to himself their feasibility that he was always able to enlist adequate forces for their accomplishment. With a mind thus constituted, success was not problematical; to him it was a demonstration; and he had that rare combination of qualities that enabled him to inspire others with the same conviction, so that, whether he lived to see the completion of his work or that his own end should be reached in advance of it, he had that sublime faith in its success that he could give his whole energies to it without a shadow to mar his efforts. He was of delicate and refined tastes, and especially fond of poetry, of which his retentive memory gave him large command. In social life he was always courteous and kindly, endowed with both wit and humor. He was a most agreeable companion. He had the happy faculty of adapting himself to those with whom for the moment he found himself, so that young and old, cultured and uncultured, enjoyed his society.

Perhaps few men are heroes to those who know them intimately, but those who were nearest to Mr. Eads honored and loved him most.