BIOGRAPHICAL NOTES.

A knowledge of its author greatly increases our interest and assists in forming an estimate of the value of a book or paper. The logic may be good, the thought clearly and well expressed, but, unless we know that they are supported by experience, we are haunted by a suspicion that the author is only a theorist, after all. We want to know not only what he thinks but why he thinks as he does. These reasons alone make it advisable to insert here a biographical sketch of the author of the papers which follow. No information, however, is of such universal interest and is so eagerly sought as that pertaining to the lives of successful men.

The older man draws courage and comfort from a knowledge that a more successful man had advantages superior to his own and is gratified to find himself more successful than one who has had similar opportunities. He is also strengthened by a glimpse of an honorable conclusion of his own course as evidenced in the lives of others.

But the young man finds in the lives of noted men his own inspiration. He is much encouraged to find that the great man was not always great, but had battles similar to his own to fight. What another has done he believes he can do, and the story of the successful man's life shows him the way. The line of work may or may not be the same; that makes no difference; for courage, intelligence, energy, and integrity will produce the desired results in any line of work. Often a glimpse of a course successfully pursued will solve a knotty problem and make clear to him the procedure most advisable in his own case. Good advice from older men is generally acceptable, but the lessons drawn from experience, one's own or another's, are always more thoroughly learned and, consequently, produce better results.

John Alexander Low Waddell was born at Port Hope, Ontario, Canada, January 15th, 1854. His father, Robert Needham Waddell, was born at Newry, Ireland, in 1815, and came over to Canada in 1831. His mother, who is still living, is a daughter of the late Colonel William Jones of the Seventh Regiment of New York, once Sheriff of New York City, and again a member of the state legislature.

Until his ninth year Dr. Waddell was not sent to school but was taught by his mother at home. Then he was sent to the common or public schools of Port Hope for two years. In 1865 his father was appointed high sheriff of the United Counties of Northumberland and Durham (a high office, which is judicial as well as ministerial under English laws), and removed to Cobourg, the county town. He attended various grammar and private schools there, then spent a year or more at Trinity College School in Port Hope. His sixteenth year found him in rather delicate health and

lacking in physical development, the effect of hard study, hence he was sent to China as a passenger on the noted tea-clipper "N. B. Palmer" of New York. The ten months' voyage to Hong Kong and Shanghai and return had the desired effect, for he gained greatly in health and strength during the trip.

Five months were then spent at a business college in Toronto, and in the fall of 1871 he matriculated at the Rensselaer Polytechnic Institute, Troy, N. Y., where he graduated with the class of '75.

His preparation for college followed the good, old classic lines in which the Greek and the Latin languages were prominent. The work in these languages was very distasteful to him and caused him to dislike them exceedingly. He has frequently referred to the time spent upon them as time wasted, and fails to recognize what more than one reviewer has pointed out, their salutary effect upon his English. He is, however, an excellent French scholar, and retains and makes frequent quotations from the Latin. Owing to their lack of training in the Latin and the Greek languages, engineers, as a rule, do not use enviable English. A knowledge of the roots, the foundation of the language, is essential to nicety and facility in its use.

Armed with the degree of Civil Engineer from the oldest and then almost the only school of engineering in this country, Dr. Waddell began his professional career as a draftsman in the Marine Department of Ottawa, Canada, where he spent a few months designing buoys, lanterns, and similar marine appliances.

Then he received an appointment as rodman on the Canadian Pacific Railway, which was being built by the Dominion Government. Fourteen months on preliminary, location, and construction work near Port Savanne brought him much hard work and experience, but small advancement and smaller pay, the usual compensation of the young engineer. He then resigned his position with the Government to make an engagement with several contractors who were building sections of the road, and remained in the bush about four months longer, till the contractors' work was finished.

Following this came about eight months of enforced idleness, probably the most difficult position a young and ambitious engineer ever occupies. Part of this time was spent in coaching his brother, Robert, who entered McGill University very late in the term, but with this assistance was enabled to attain full standing before the end of the scholastic year.

The next summer he obtained a subordinate position on the bridge over the Missouri River, at Glasgow, Missouri, but the great heat and the malaria broke his health and forced him to give up the work after only a month of service.

He soon obtained the position of engineer for a coal mining company in West Virginia, where he did the surveying both above and below ground, and designed and built a ventilating shaft and other mine structures.

In the fall of 1878 the mining work was given up for the position of Assistant to the Professor of Geodesy and Descriptive Geometry at the Rensselaer Polytechnic Institute. This was the beginning of six years' work as an educator, years which afforded time for further study and for writing on technical subjects. Shortly after taking up his work as an instructor, an opportunity appeared to obtain a better position, that of Assistant to the Professor of Rational and Technical Mechanics, and, after several months' study in preparation, he obtained that position, which he occupied until the fall of 1880. While engaged in this work, one of those lasting friendships, which are of incalculable value to both parties, was formed with his immediate superior, Professor William H. Burr, now of Columbia University and a member of the Panama Canal Commission.

In January, 1881, Dr. Waddell was appointed Chief Engineer of Messrs. Raymond and Campbell, a firm of bridge builders whose headquarters were in Council Bluffs, Iowa, and began his work in bridge engineering, the specialty to which he has since devoted himself almost exclusively. This engagement was terminated in the summer of 1882, when he went to Japan to take up again the work of an educator.

Very early he began to write technical papers, many of which were published in the transactions of the "Pi Eta Scientific Society," now the Rensselaer Society of Engineers. Among them were "Railroad Drainage" and "Notes on Railroading," which are reprinted in this volume; "Wave Motion Applied to Light Houses" and "Compensating Trusses," which have not been preserved; and "Bridge Pins, Their Sizes and Bearings," "Highway Bridges" and others which were later incorporated in his book, "The Designing of Ordinary Iron Highway Bridges." These papers attracted considerable attention, and early in 1882, brought from the Japanese Government the offer of the Chair of Civil Engineering in the Imperial University of Tokyo.

July 13th, 1882, he was married to Miss Ada Everett, the only daughter of Horace Everett, Esq., of Council Bluffs, Iowa, and soon after they and his sister, Miss Josephine Waddell, sailed for Japan, where he was to take up his new duties.

The Imperial University was then in its infancy, hence the number of students was small and the work light. The spare time was employed in professional work and in the preparation of his first book, "The Designing of Ordinary Iron Highway Bridges," which was published in 1884 by Wiley & Sons of New York. The science of bridge building was then by no means so well advanced as it is now and very little had been written on the subject, hence the work, which was exceedingly full and thorough, was very widely accepted as a standard text-book and still had a steady sale only six years since, when, at the author's request, it was declared out of print. The theory and much of the practice which it contained are still sound, but iron is no

longer the material of which bridges are constructed, hence the book is of no further service to the profession.

Immediately after the publication of this book, the preparation of "A System of Iron Railroad Bridges for Japan" was begun at the request of the University authorities. This Monograph was published early in the summer of 1885, and immediately gave rise to a spirited controversy, for its author had severely criticised the methods of English engineers, as they were exemplified in the Japanese railway bridges, most of which were of English design and fabrication. The "Japan Mail" reviewed the Monograph July 16th, 1885, and immediately, not the Monograph but its author, was bitterly attacked in numerous letters addressed to the "Mail." Throughout the controversy, which continued for nearly a year, the English engineers gave evidence of their professional weakness by avoiding as far as possible a technical discussion of the subject and by confining their arguments to personalities and to generalities, many of which were half-stated or purposely misleading. In his letter of October 7th, 1885, Dr. Waddell states: "Into the merits of the case not one of the writers of the letters in the 'Mail,' attacking my book, has dared to enter. An open, scientific discussion is, apparently, the very last thing my opponents desire. They know that it would make patent to the world the radical deficiencies of the old English system of bridge building." An editorial note adds, "We have published a number of letters—so many that our readers must be weary of the subject—and yet, as Mr. Waddell says, the point at issue is as far as ever from settlement." Thus for three months the discussion had been almost venomously personal on the part of the English engineers. A number of Japanese engineers, an American engineer, Professor W. C. Kernot of the University of Melbourne, and Dr. Waddell carried on the scientific side of the argument, which continued for several more months, but gradually took on a more technical character and resulted in completely establishing the soundness of the memoir. It was a pretty quarrel in which a young man of but ten years' experience won over many old and long-established engineers, but practice has changed so greatly in less than twenty years that its technical interest is small now.

In the spring of 1886, at the end of his fourth scholastic year of Japanese service, Dr. Waddell determined to return to America. He was handsomely treated by the University authorities, and still has in his possession many highly prized presents from Japanese friends. Later the Emperor decorated him by bestowing upon him the order of the "Rising Sun," with the rank of Knight Commander.

Before Dr. Waddell left Japan, Professor Burr, who was then Engineer for the Phœnix Bridge Company, arranged for him to settle in Kansas City, Missouri, as the Western representative of the Phœnix Bridge Company and the Phœnix Iron Company. Though his efforts were, in the main, to be devoted to the interests of these companies, he retained the privilege of prac-

ticing as a consulting engineer as well. In order to acquire a knowledge of the companies' methods, the last five months of 1886 were spent in their works at Phœnixville, Pennsylvania, preparing competitive designs and estimates for several important bridges, at least one of which was built.

Realizing that he was quitting permanently the life of a professor, he prepared a very comprehensive paper on "Civil Engineering Education," which was published in Engineering News. It appeared in the issues of January 1st and 8th, 1887, and was discussed in later issues by a number of prominent engineers and educators. It is reprinted, with these discussions, in the pages which follow. It is noteworthy that, while the extremely thorough five years' course advocated has not been adopted, the advance in engineering education has been largely along the general lines laid down in this paper.

January 1st, 1887, Dr. Waddell opened an office in Kansas City, and, from the first, was successful in obtaining contracts for the companies he represented and engagements as a consulting engineer. The street railway companies and several other parties gave him contracts for metal work to be built by the Phœnix Bridge Company, while, as a consulting engineer, he reconstructed the bridge over the Missouri River at Fort Leavenworth, Kansas. The bottom chords of this structure, which is of the Post truss type, had been seriously injured a year or two earlier by a fire which destroyed the wooden floor system; and, though unscientific detailing in the original design made the task difficult, the work of reconstruction was so satisfactorily done that the bridge is still in service.

While representing the Phœnix Bridge Company, he obtained in competition several noteworthy pieces of work, among which may be mentioned the designing of an elevated railroad (valued at about half a million dollars), connecting the Merchants' Bridge and the Union Depot in St. Louis, and the Red Rock cantilever bridge over the Colorado River between California and Arizona. After preparing the preliminary plans, making the estimate, and taking the contract, in a very limited time on the ground, Dr. Waddell was retained by the Railway Company as its Consulting Engineer, to supervise the detailing of the Red Rock bridge at Phœnixville. At the time of its construction this was the longest cantilever span in America, and, until very recently, has only been surpassed by the Memphis Bridge over the Mississippi River. The loads which now pass over the structure greatly exceed those for which it was designed, but it is still doing good service.

As mentioned above, our author sometimes occupied the dual position of representative of the Phœnix Bridge Company, for which he took the contracts, and consulting engineer for the railway company which purchased the structure. As his consulting practice grew, the excellence of design received increasing attention, and it became more and more difficult to bring into agreement the construction which, as consulting engineer, he should

obtain for his client, and that which, as contracting engineer, he must offer for the bridge company if he obtain contracts in competition. In consequence, the contracting business decreased in volume until 1892, when he resigned the agency for the Phœnix Bridge Company and the Phœnix Iron Company, and thenceforth devoted himself entirely to consulting work.

On January 1st, 1899, his principal assistant engineer, Mr. Ira G. Hedrick, was admitted to partnership, and the firm became known as Waddell and Hedrick.

A consulting engineer's practice is largely composed of structures of ordinary types and proportions, but Dr. Waddell has been responsible for a very large amount that is noteworthy in both size and character. In 1892 he was appointed Chief Engineer of the Pacific Short Line Bridge Company, for which he designed and supervised the construction of a combined railway and highway bridge over the Missouri River at Sioux City, Iowa. This structure, which cost about a million dollars, consists of two five hundred foot fixed and two four hundred and seventy foot draw spans and the approaches. The foundations are very deep and were sunk partly by the pneumatic process and partly by open dredging.

As Chief Engineer of the Omaha Bridge and Terminal Railway Company, he designed in 1893 a double track railway bridge across the Missouri River at East Omaha, Nebraska. The draw span at the eastern end of the bridge and the pivot pier supporting it were of steel and masonry respectively, while the fixed spans, the other piers, and the approaches were temporary only. The spans were of the combination type, the piers were constructed of piles, and the approaches of timber; but these have recently been replaced under the direction of his firm by a permanent structure with steel spans and masonry piers. The center line of the temporary bridge formed an angle of eleven degrees with that of the permanent structure, hence the new piers and spans were constructed without interfering with the temporary structure or delaying traffic, and when the new portion was completed, the old draw span was revolved eleven degrees and forms a part of the new structure. Owing to the shifting of the channel of the river, it has been necessary to construct another draw span at the western end of the new structure, thus the bridge has two draw spans, each five hundred and twenty feet long, the longest yet constructed. On all the spans provision is made for brackets which will carry a motor track, a roadway, and a sidewalk outside of each truss, but these will not be added till demanded by the traffic.

In 1893 a lift bridge, carrying Halsted Street over the South Branch of the Chicago River, was designed and constructed for the City of Chicago. A paper treating of its construction was presented to the American Society of Civil Engineers and is reprinted here, rendering description unnecessary, but it may be added that the bascule type of bridge has since been so satisfactorily developed that another great lift bridge will probably never be

constructed. The structure has been very satisfactory in its operation and will, no doubt, continue in service for many years. Notwithstanding its great height, it is a sightly structure and is a highly creditable piece of engineering.

A steel highway bridge across the Missouri River at Jefferson City, Missouri, is also worthy of mention. It rests on steel cylinder piers which were sunk by the pneumatic process, and consists of a four hundred and forty foot draw span and two three hundred and fifty foot fixed spans and the approaches.

In 1893 Dr. Waddell was retained as Consulting Engineer for the Northwestern Elevated Railroad and the Union Loop Elevated Railroad of Chicago. The former consists of about six miles of four-track structure, built on private right of way, and about one mile of two-track structure built in the street, while the latter consists of nearly three miles of double track structure forming the four sides of a loop around the most congested business portion of the city. The merits of various designs of superstructures and foundations were thoroughly investigated before even the general plans were prepared. The results of these investigations were recorded in a paper presented to the American Society of Civil Engineers in 1896 and form an exceedingly valuable addition to the literature of the subject. The paper, together with the discussions to which it gave rise, appear in this volume.

Dr. Waddell was consulted in the preparations of the plans for the Boston Elevated Railway, and has occupied advisory positions on much other important work.

Since the partnership with Mr. Hedrick was formed, the firm has designed and superintended the construction of a very large amount of bridge work in the United States, Canada, and Mexico, and some lighthouses and bridges for Cuba. The most noteworthy of these structures is a Y shaped railway and trolley bridge over the Fraser River at New Westminster, British Columbia, and the construction of a temporary suspension bridge over the Kansas River at Kansas City. An unprecedented flood swept away one and greatly damaged the second span of the bridge which brought the city's water supply across the river, but with unskilled labor and whatever material was available, Messrs. Waddell and Hedrick repaired the damage and replaced the destroyed span while the flood was at its height. Heroic work under exceedingly dangerous conditions was required, but the city was threatened with disease and was helpless in case of fire, hence it was essential to work continuously night and day for a week until the structure was completed.

Messrs. Waddell and Hedrick have recently been retained to design a railway bridge over the Strait of Canso, Nova Scotia. The preliminary studies indicate that a cantilever bridge having a clear span of more than eighteen hundred feet will be required.

By the time this volume comes from the press, the firm will have nearly completed an elaborate investigation of the properties and economics of nickel steel for railway bridges. This investigation will probably determine whether the large bridges of the future will be of the cantilever or the suspension type.

Although Dr. Waddell has originated many new features of bridge design which are of commercial value, only a few have been patented, the great majority being freely given to the profession. In 1893 he patented an "A" truss bridge which has been extensively and satisfactorily used for railway bridges. It possesses great rigidity and is much more economical than the plate girder for spans of about one hundred feet.

In 1894 he was granted a very broad patent on the principal features of the Halsted Street Lift Bridge, and in 1898 he obtained a patent on an automatic jetty for improving tidal ways. The jetties are provided on the harbor side with a continuous door, hinged at the top, which will open readily and permit the tide to flow into the harbor freely, but which will close automatically and force the outgoing tide to flow through a narrow channel which it will deepen by erosion.

In 1898 a patent was granted to Messrs. Waddell and Hedrick on a suspension bridge stiffened by cables in the form of an inverted catenary placed below the floor instead of the usual stiffening truss. A bridge of this type has lately been constructed in British Columbia.

In 1903 the firm patented a plan for constructing a long-span single-track railway bridge so that it may later be converted into a double track structure. The cost of the single-track bridge will be but slightly greater than that of the usual structure of that type, yet the total cost, when the second track is added, will not be greatly in excess of that of an ordinary double track bridge.

Throughout these years of great professional activity, Dr. Waddell has continued to contribute his quota to engineering literature. Shortly after settling in Kansas City, he wrote a pamphlet entitled "General Specifications for Highway Bridges of Iron and Steel," which was submitted to prominent bridge constructors throughout the country. A second edition, containing discussions by various engineers and contractors, was distributed about a year later. In 1893 a paper on "Some Disputed Points in Railway Bridge Designing" was written and presented to The American Society of Civil Engineers. This was followed by a paper on the Halsted Street Lift Bridge and a very full and thorough paper on Elevated Railroads, both of which were presented to the same Society.

"De Pontibus," a very valuable book treating of the general principles of designing and detailing bridges and supplementing the usual text books on that subject, was published by Wiley and Sons in 1898. Two years later the

same firm brought out a volume entitled "Specifications for Steel Bridges." Both have been very favorably received by the engineering profession.

A short paper on "Foundations for Important Buildings in the City of Mexico" and another on the "Flow Line Bridge at Kansas City" complete the list of technical papers.

Dr. Waddell's interest in engineering education has never flagged, and much of his time has been given to matters pertaining to it.

Early in 1882 McGill University conferred upon him the *ad eundem gradum* degree of Bachelor of Applied Science, and in June of the same year gave him the degree of Master of Engineering, after he had passed a very severe examination. The same institution recognized the high value of his scientific work by conferring upon him the degree of Doctor of Science in April, 1904; and in June of the same year Missouri State University honored him with the degree of Doctor of Laws.

In addition to the paper on Civil Engineering Education, previously mentioned, papers on Civil Engineering Education in Japan and on the Advisability of Instructing Engineering Students in the History of the Engineering Profession have been presented to the Society for the Promotion of Engineering Education. Numerous lectures have been prepared and delivered to the students of various educational institutions throughout America. Several of the most valuable of these are preserved in this volume.

A report recently made to the head of a prominent educational institution and an address on "Higher Education for Civil Engineers" contain Dr. Waddell's latest ideas on the subject of instruction in engineering.

At the invitation of the Directors he addressed The International Congress of Arts and Science at The Louisiana Purchase Exposition in September, 1904, upon The Relations of Civil Engineering to Other Branches of Science. The address is printed in the succeeding pages. His interest in the engineering societies has always been strong. He joined the Pi Eta Scientific Society, now the Rensselaer Society of Engineers, in 1872, and was elected a Member of the American Society of Civil Engineers in 1881; an Associate Member in 1883 and a Member of the Institution of Civil Engineers in 1899; a Member of La Société des Ingénieurs Civils in 1887; the Canadian Society of Civil Engineers in 1903; and an Honorary Member of the Kogaku Kyokai, the Japanese Engineering Society, in 1886. In 1893 he became a Charter Member of the Society for the Promotion of Engineering Education. He was a Charter Member of The American Society for Testing Materials and chairman of its committee on structural steel. He was a Member of the Engineers' Club of Kansas City, which is now defunct, and resigned his membership in the American Society of Mechanical Engineers, the Western Society of Engineers and the Engineers' Club of Philadelphia.

In June, 1904, the Missouri State University chapters of Phi Beta Kappa and Tau Beta Pi elected him to honorary membership.

Every successful engineer works hard; there is no royal road to success in any branch of the profession; but Dr. Waddell has found time from an exceedingly active professional life to enjoy much true sport. Whist has occupied much of his attention and he was thrice President of the Kansas City Whist Club, and each year several weeks are devoted to shooting and fishing. He is acquainted with every part of this continent where good sport is to be had. He has caught the tarpon in the Gulf of Mexico; the bass, pickerel, and muskellunge in Wisconsin and Minnesota, and the salmon in Canada; has shot deer in Arkansas, deer and elk in the Rocky Mountains, and small game in many sections of the country. A recent number of "Forest and Stream" contains a reference to him as a sportsman which is well worth reproducing here.

ENGINEERING AND FISHING.

Our frequent contributor, Mr. J. A. L. Waddell, of Kansas City, Mo., is known to the readers of our angling columns as a successful tarpon fisherman and angler for other big game fish. Mr. Waddell is one of the most distinguished bridge engineers of the United States, and has undertaken enterprises also in Mexico, Cuba, Canada and Japan; for his work in Japan he has been decorated by the Mikado. Engaged in important work in bridge building in various parts of the country, he enjoys the rare good fortune of finding opportunities of indulging in his favorite recreation in connection with his professional duties. His engineering enterprises in Mexico have borne fruit for tarpon fishermen in the series of articles on tarpon fishing written out of his experiences there. On the way to and from British Columbia, Mr. Waddell has found opportunity to test the rainbow trout; and while on professional visits to Nova Scotia he has drawn attention to the possibilities of the sport of tuna fishing in Atlantic waters. Mr. Waddell is the author of several authoritative works on bridge engineering, and, as might be expected, his fishing papers are intensely practical. They have less of the poetry of angling and more of the useful, instructive and definite description of tackle and modes of fishing.

It need not be added that Mr. Waddell is a strong advocate of the value of field sports from a purely business and professional point of view. He believes in play as a necessary complement of work; and not only does he practice the doctrine, but on occasion he preaches it and urges it upon the younger men in the profession. We have before us an address delivered by Mr. Waddell to the graduating class at this year's commencement of the Rose Polytechnic School. The burden of the address is to celebrate industry,

application, study, and work as the essentials of professional advancement and success; but with all these the value of recreation from toil is not forgotten. One of the concluding paragraphs may well be quoted as having application to other professions than that of the engineer:

"By this time you all have probably come to the conclusion that you have been listening for the last half hour or more to an old fogy, who thinks that there is nothing in life worthy of consideration but work, work, work, and who can talk on nothing but technical subjects. If this be so, I by no means blame you, for you would seem to have reason on your side; nevertheless, you would be entirely in the wrong, because I am a firm believer in legitimate relaxation of every kind, and in a man's getting all the pleasure he can out of life. Perhaps, too, I could talk of things that are far from technical, such as hunting the great game of the Rocky Mountains, canoeing on lake and stream, the shooting of rapids, travels in foreign countries, gunning for wildfowl in the marshes, sports afield with dogs and gun, fly-fishing for trout in the streams of the far North, and struggling with the gallant tarpon on the waters of the Gulf of Mexico; but it was not to discuss such subjects as these that your president brought me here, so I shall desist, only remarking that the more you mix these things and other 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 citizens will you become, and the more interesting and agreeable will you prove to all with whom you are thrown in contact."

It is hardly necessary to add that throughout his active career Dr. Waddell has always found time to devote to his many close and true friends. Many a young engineer owes much of his inspiration and success to the friendship and personal assistance of this busy engineer, while many more have been encouraged and strengthened by the many lectures and addresses which he has snatched the time to prepare and deliver to them. He is a devoted husband and father, a public-spirited citizen, and a thorough sportsman, while his energy and his ability have gained for him a high position as an engineer.