NATIONAL ACADEMY OF SCIENCES
OF THE UNITED STATES OF AMERICA
BIOGRAPHICAL MEMOIRS
VOLUME XXII—ELEVENTH MEMOIR

BIOGRAPHICAL MEMOIR

OF

WILLIAM LE ROY EMMET

1859–1941

BY

WILLIS R. WHITNEY

PRESENTED TO THE ACADEMY AT THE AUTUMN MEETING, 1942

WILLIAM LE ROY EMMET

1859–1941

BY WILLIS R. WHITNEY

In attempting this biography, I am actuated by two separate motives. First; a wish to satisfy the request of the Academy, and then the sincere hope that I may do some good to young men who may be influenced by Emmet's precepts and example, in the problems of ever-bettered living.

Anyone who has read Dr. Emmet's "Autobiography of an Engineer" will wonder why I do more than abstract parts of that book, where everything is plainly and forcefully written, and so interestingly condensed. There the real character is exposed.

But I look at Emmet's life as more instructive to the youth, than is succinctly explained in the book. The book is more an unusual practice than a preachment, and the reader may be diverted by some oddities. So, meditation may be in order. The world's views on how best to live, are not especially tangible or in agreement; and Emmet had a way that proved good. People everywhere are apt to think pretty much as they are early advised to do, and they often do, without strenuous effort, about what the average does. This in itself may be an efficiency-agent for general survival. It may preserve, but it does not advance civilization. It is even questioned by modern metaphysicians, whether real advance is desirable or continuously possible, and whether we are any better off in our infinite artificial complexities, than the monkeys in the palm-trees, who by merely extending their arms, get food and pleasant drink, while enjoying both in the protecting shade.

Emmet early acquired a different and more efferent view. In his early youth he had stubbornly struggled to improve his own opportunities, while authorized teachers (of far less persistence) "marked him down." Finally he had experimentally proved that he did not have to remain submerged. He always felt that anything could be improved if it were rightly attacked, even Emmet. It was that idea, rather than any accumulated data of pure science, which later determined his admitted success. He always worked hard, even into his "80's". To some friends, his ways seemed the most difficult. No one would have called him a patient man, but persistence was almost personified in him. He continually battled against himself and against deficiency in other men and materials. He would weepingly condemn himself forever, because of some slip of a golf-stick but he would loan money to almost anyone without critical feelings.

Mr. Emmet was what is properly called a research-engineer and one of rare ability, inquisitiveness and dynamic force. The engineer is usually a man who, knowing the physics of matter, and strengths of materials, together with prospective and current costs, constructs through the help of men and machines, structures such as will endure under the probable load of use and some abuse. But engineering continually changes in our days, and the manufacture of the newer products is due to the faith and works of the productive engineer. Those who, like Emmet, are never satisfied to stop improving designs, account for our new and better buildings, bridges, motors, tanks, locomotives, aeroplanes, etc. Thus the good engineer advances the "calling" itself by conservative but fearless use of new discoveries. Emmet was a research-engineer because he so often undertook difficult researches in order to help supply the data needed by engineers in order to design newly.

If it were not a hallowed custom, I might have declined writing this article, but a fairly close association with Mr. Emmet for about forty years decided it. The American Society of Mechanical Engineers published his autobiography in 1940. In that book of 225 pages one may read a very detailed story of his life. It is an intimate and revealing picture of a man who was always trying to serve his race. There too one sees those remarkable abnormalities of mind and hand, persistence, egotism, friendly good-will, non-conformity, non-complaisance, and kindness, which were outstanding parts of his personality. He was certainly "different." He knew it and gloried in it. He even wanted youth to understand and benefit by it.

He was born July 10th, 1859, on Travers Island, near New York, and was one of ten children. His great-grandfather was

Thomas Addis Emmet. Thomas was the first of the family to migrate to America. Thomas was the elder brother of the heroic leader of the ill-fated Association of the United Irishmen, Robert Emmet. Robert was executed after the failure of his Dublin plot (1803) and his memory remains forever green in the hearts of the Irish. Thomas being banished, came to this country, where he became very successful and honored. He was at one time Attorney General of New York State. His son in turn (also named Robert) born in Dublin in 1790, "a man of very fine physique, temperate, clean and of excellent understanding," was William Le Roy's grandfather, and his father was William Jenkins Emmet. Thus grand memories and some genetic forces of fighting spirit and loving disposition were evidently dominant in his heredity. Of his mother, whose maiden name was Julia Colt Pierson, he wrote: "I believe that a good mother is a wonderful asset, but in my case I think it can be truly said that my advantages in that respect were unusual. My mother was beautiful, noble and of extraordinary intelligence and exalted ideals."

He graduated from the United States Naval Academy in 1881 and was later a cadet on a long voyage of the U. S. S. Essex. This was a sailing vessel with a steam auxiliary which gave much trouble. Salt water was used in the boilers and these had to be frequently "blown-down" to keep the salt content below a certain limit. Such experiences evidently gave him much desirable knowledge of the practical improvements to be made in the propulsion of Naval vessels.

Before selecting items of his success, let me give my own picture of what I saw in his mind during four decades of contacts. He always looked upon himself as "a hound for detail" but highly forgetful and most absentminded. Truth is very exacting; and close contact with it led him to make many experiments where others may have delved less carefully. He thought that individual mental power, originality and directive ability were about as lacking in the "good scholar" as in the poorer one and he dubbed himself a poor one. The inquisitiveness of perpetual youth, however often it may be discouraged by those "Who ought to know better," was his asset. Admitted ignorance is a firm foundation for the buildings of natural curiosity. For that reason he never hesitated literally "to stick his neck out," whether it was about the structure of the moon, the social theories of President Wilson, the weakness of other men, his own handicap at golf, the economy of steam generation, some vagary of ice-curling, salmon fishing or of moose hunting. He was mentally omnivorous. He had no fear of ridicule. He frequently wrote such self-evident truths as: "I think that my ideas are valuable." But I am sure that he visualized in the possible developments, the addition to his knowledge which came through the contributions of ideas of others who in various ways felt forced to correct him if possible. It was doubtless for that end that he knowingly and persistently "put out his feelers." Having no false mental reserve, he sensed the great values of verbal contacts. At one time he could write: "The men with whom I came in contact did not understand me at all and did not see my possibilities." Again, "I gave the chief engineer the benefit of my opinion but if he had known that he was talking to a great engineer, he might" etc., and again "many good specialists are not experimenters. Their tendency is to think that their science is sufficient for all needs, which is always a very erroneous idea." . . . "In engineering, the leader must know the detail, and force others to it." . . . "All of which goes to show that the teacher is not always right." . . . "It is better to seek arts and facts rather than other people's opinions."

But he always acted as though he knew that nature held in front of him an endless number of interesting and productive new laws, materials and technical novelties, and that even in our day, they were only to be approached slowly and under considerable difficulty.

It would be a serious mistake to overlook the all-roundness of Mr. Emmet while trying to do justice to his engineering powers. I know of no one who so intelligently conjoined vocation, vacation and avocation. In his early days in Schenectady he was constructively active in introducing there such outdoor sports as skiing, skate-sailing, ice sailing and also always contributed some related novelty such as a new harness for skiis or a bow-shape front edge for a skate sail. Many friends learned about his skill as a fisherman by being notified at the Mohawk Club that a fresh salmon for him was in the ice box sent from some remote river by Mr. Emmet.

With our modern engines, motors, movies, radios, x-rays, television, cyclotrons and electron-microscopes, he saw how much men learn from healthy curiosity. He saw that man never need be satisfied, though he could oppose dissatisfaction. "Unsatisfied" was his motto. He clearly and hugely enjoyed difficult engineering. He did more than his part in releasing power of new service from nature's boundless box of still unrecognized servants. That is a sort of liberation which may go on forever (if history from the Stone Age is any criterion). And to quote a recent address: "It will be impossible to put back into their bottles the genii which have been released."

As an illustration of possible advantage of the biographer over the autobiographer, I shall emphasize from Emmet's life some of the points in modern engineering which young ambitious men should know. For example: after leaving the Navy, Emmet tried, more or less unsuccessfully, several different ways of making his living. One of these was as helper in the arc lamp factory of the United States Illuminating Company in New York. This was in '86 when electricity was less understood, and those in the lamp industry knew so little about it that Emmet, because of his schooling with motors and generators at the Naval Academy, was able to acquire and use much practical electrical knowledge. Here was a turning point in his self-confidence. He had little self-confidence at the time, "although that has been my strong suit in later life."

Those who knew him intimately saw that his confidence was his winning card. But I want to point out that, with such isolated individuals (even most inventors), there is always present the danger of failure before their promising undertakings can be completed. This is part of the explanation for our large long-lived American-type manufacturing organizations. Here Emmet was made successful. Here experts of different lines—from conceiving, experimenting, engineering, financing; through manufacturing and profitably selling,—combine and cooperate for success. Emmet's life well illustrates this point.

In sharp and sad contrast to it was the life of his first employer, the fervid, lone-eagle, entrepreneur Frank Sprague. In our present large industrial undertakings, it is not enough to have conservative engineering, or even that of bolder type. Support is needed. After a long life of arduous electrical promotion and engineering, Frank Sprague died impoverished; Emmet, wealthy. They seemed quite alike in their boundless energy, enthusiasm, engineering strength and personal boldness. Both were trained in our Naval Academy, though in different classes. Both were outstanding members of the Naval Consulting Board of 1917. Of him Emmet wrote: "There are few men in the electrical industry who have been more uniformly right than Frank Sprague, and I always had a great admiration for his intelligence, originality and courage."

In his formative years Emmet had designed, manufactured and sold some of his brain-children. But his life afterwards showed that he could conceive and design much greater contributions to electrical development than almost any individual could both design and produce. When he came to Schenectady (he says) "It was a very important move." He came into contact with many business men and also those skilled in arts, together with their machines. He thus rapidly extended his mental scope and realized "That with the facilities in men and machinery now available, I ought to be able to do good work." This conclusion well fits into the picture of organization where each of many different ambitious specialists devotes his personal abilities to working with others. Such is a reason for modern large industrial corporations.

Emmet wrote later: "I have never had any idea of leaving Schenectady, although I have had very attractive offers of other work. I have had no desire for promotion, have avoided executive duties as much as possible, although I have demonstrated that I can handle them ably, and my position has been very much what I chose to make it."

Together with this, ought to be taken the facts that among other activities, such as planning and selling the largest steam turbine, he also designed the radically novel electric propulsion apparatus for ships and personally gave information to prospective purchasers. Our Navy vessels are now in many cases driven by his propelling devices.

Thus Emmet was not seriously restricted in his efforts, and on the other hand he was relieved of duties gladly shouldered by men particularly trained for them, who took pleasure all their lives in helping his dreams come true.

It was characteristic of Mr. Emmet not to harbor his ideas, but to launch and sail them forth in any sea, where they had to sink or float, "on their own." I admired that character. At one place in his book, he criticised President Wilson for thinking and saying that employees of large corporations were to be pitied because forced to do the bidding of their superiors, etc. Emmet wrote: "in this he is almost completely wrong, because he, like most political critics of industry, had not had opportunities of knowing its complicated conditions. The idea that he (the employee) is less independent than the man employed by smaller concerns, is utterly fallacious."

He vigorously defends "largeness" with such words as "wrongdoing by large concerns is for many reasons difficult and unsafe." By that he called attention to the fact that men usually pull well together when the integrity of all is evident to each. And it becomes dangerous in such a group, to suggest ways unethical or low-aimed. When men are "in conference" they usually put forward only their best thoughts. A low-down thinker is apt to be excluded.

Emmet's pioneering in the problems of steam turbine is one of several cases in which a radical engineering experimenter was given his grand opportunity by adequate support. At the time, it was a burning question whether the principle of the steam turbine could be made to compete with the existing reciprocating engines which had had such long and continued improvement. Curtis in America and Parsons in England had not proved the technical advantages in cases of large power turbines; though it seemed promising on paper. Mechanical developments and suitable materials had not "arrived." The facts at this stage forced engineers to question the technical outlook, even after three years of intense local development. At this point Emmet met Curtis and became convinced of the basic idea that continuous rotation of the pressure-surfaces had such great advantage over the stop and restart of reciprocating pistons, that it must ultimately succeed. Efficiency of power production from fuel, which was ever afterwards Emmet's life-aim, had still not proved so high for turbines as for standard type steam engines. Emmet, though claiming to be no thermodynamist, felt so certain of the turbine-future that he at once accepted the difficult job of proving its value. Through the cooperation of many men, minds and machines, success followed the bold venture. After five years of painful effort and frequent disappointment he could then write: "We developed an enormous industry and put practically every engine builder in the country out of business so far as the driving of electrical apparatus was concerned." Injuring others was never his aim, but almost anyone can appreciate the great advantage to electrical manufacturers of controlling and making their own complete power plants.

A typical Emmet act is recorded by him in his relations with Mr. Junggren, who was his manufacturing agent for all the detailed work. He had great faith in Junggren, but because Emmet was an experimenter, things did not always go smoothly, and he had "many long contests with him." But when Junggren received a flattering offer of work elsewhere, Emmet reports the outcome as follows (which shows the honest Irish wit so dominant in him): "I told Mr. Rice (Chief Engineer) that I was spending too much of my time contending with him and I could get along better without him. He asked me what he should do about letting him go, and I told him to pay his price and *hold* him, an action of which I have always been glad." They worked together happily for many years afterward.

Of Curtis, whose ideas were made practical by Emmet, he wrote: "When he was given the Rumford Medal at Harvard, I was in the audience and he did not know it. He spoke more of my doings than of his own and in fact did not do himself justice at all." (Emmet-like.)

Sensitive to the needs of coming engineers, Emmet, when he had learned of the possibilities and advantages of the more modern alternating current over the predominant direct current, proceeded to write a book on the subject. This was a highly appreciated step in education by a busy man.

His long life was filled with attempts to devise improvements in electrical fields. His introduction of mica tape winding, together with forced air-circulation for more effective cooling of large apparatus, was called-for by the rapid advance in the then new aluminum industry, where the largest then known alternating currents had to be changed into direct current. He was engaged not alone in such work of detail. It is worthy of note that he wrote as follows: "The more a man originates and tends to depart from the beaten path, the more he has to exert himself in selling his product and in this respect I have had to be very active." But he also wrote: "While I have given the impression that various things were my doing, there were few things that I did in which others did not have a hand and many that I could not have done without able help." Too true! But he was a great catalyzer.

Nowadays when the existing interconnected alternating systems everywhere criss-cross the country, and that too with such frequency-control that electric clocks used thereon keep perfect time everywhere, we are apt to forget that in Emmet's day the problems of working alternators in parallel (without "hunting"), had still to be solved. It is an interesting part of his work which helped thus to extend the applications of alternating currents.

In many other problems of electrical engineering, he either brought about the advance by his own effort and vigorous experimental work or by instigating and encouraging others. Among such things is the long-used "varnished cambric" insulation, which soon displaced other materials like shellac. His varnish was glazed into the cambric by heat. This contributed to his aim of a thoroughly waterproof insulation. In the case of railway motors operating under ice-and-snow conditions of winter, this was of supreme importance. His work on oil switches is another case of that kind where close knowledge of details was absolutely necessary for his success. As the demands continually increased for higher and higher power, there was a natural extension of these switching and circuit-breaking devices. Here again his practical experience supplied him with what was needed.

I recall with interest that when he laid the foundations for the engineering of mercury boilers, Emmet went at once into the very simplest but fundamental experiments. Many of these he insisted on performing himself and all of them he had to witness. This gave him the "feel" of the physics of the problem. He began by using for a research-"boiler" a straight glass test-tube of about two inches diameter and six feet long. It held more mercury than we had ever seen before. Mercury boiled in this tube with troublesome "bumping" at atmospheric pressure. But this showed him at once how to go about improving boiler-tubes. The ratio of heating surface to volume of mercury had been altogether too small. He then tried a double test-tube, still of glass, one tube being suspended (submerged) within the mercury in a slightly larger tube. Here the liquid was confined and boiled in the annular space between the walls. A study was then made of the preferred space-dimensions. His aim was to use less mercury and yet give it as great surface-contact with the heat as possible, while providing also for the escape of the vapors.

This is not the place for recording his experimental troubles, but the forceful way he worked and his insistence on personal close contact with every relevant detail should be illustrated.

The experiments with glass tubes led to the design of the first steel boilers put into actual service. These were the so-called "porcupine-types," and involved the double test-tube design. Thousands of these steel tubes (welded shut at the bottom), were also at the tops welded into the large vapor-dome. This welding in those early days of a now highly developed art, seemed, and was, almost impossible. Most of the trouble (and there was much of it) was due to leaks of precious mercury through defects in welding. It was almost too early in the history of electric welding or gas welding, but this again illustrates the difficulties which Emmet like other innovators was bound to meet. He knew that such combinations of novelties as mercury in boiler-tubes and new welding processes were capable of working exponentially, just as men with individuality cooperate to an extent beyond the simple sum of their separate abilities. I think it was this peculiar knowledge on the part of Mr. Emmet which he saw as his greatest asset. It is not generally understood.

The desirable position of safety in a research engineer's work, whether it shall be "safety first," or, for future developments, some modification like "safety last," is more clearly expressed in a paper he wrote in 1904.

"Many engineers may consider the part of wisdom is to adopt only apparatus, the usefulness and reliability of which has been well established by experience. There are many cases, however, in which such reasoning cannot be wisely adopted, and among these the case of steam turbines is conspicuous." He was not guessing nor wishfully thinking, but basing this conclusion upon facts of steam characteristics. He also knew that the same forces of improvement as had led steam-engine development to continued higher efficiencies, would certainly contribute to the newly attempted but obviously promising turbine fields. There should be no end to improvements in either field, but the conservative estimated possibilities of the fresher field influenced his views. This was well warranted by the new facts which his efforts later brought to light. Improvement continued for a quarter-century. It shows no sign of ceasing.

This memoir would be quite incomplete if it did not point out that (in addition to his specific engineering undertakings) he was also a public-spirited citizen. He frequently contributed to social discussions in the press and he addressed socialistic gatherings always with the idea expressed by him: "The hope of future generations lies in the evolution of a race which has judgment, foresight, and providence; and we cannot hope to produce it by giving people the "sheltered life." He believed in democracy with a minimum of government and he refers to Socialism as representing a maximum of government. "As our society becomes more complicated the activities of government must extend, but for growth and productiveness we must always look to the individual and if his opportunities are much restricted, our civilization must correspondingly shrink." To him, civilization was a going process and not merely a product.

It has something changeable for better at all time,—not static, but hugely dynamic, with possibilities which are limited only by the degree of personal liability and personality which our form of government has fostered in its people.

He was a democratic worker too and highly appreciated the contributions to industry which come from men who take pride in their individual skills. This was the advantage of large organization which Emmet understood. Why Europe is not more productive of inventions than America, he ascribed to "too much dependence on learned doctors rather than on the common man of little education." "Europeans tend towards being somebody while Americans tend toward doing something." The initiative of individuals can create an interlocking system where any pretext of rank in the group is displaced by rising individual ability. In absence of such contribution, "society tends to become less ebullient and the rise of native ability becomes less easy and natural." He often expressed great interest in the fact that everywhere in nature, not only among men, there exists the great mass of general activity in which a few individuals by unusual mobility, rise to visible heights of some sort of helpful service. They are abnormal but they determine the rate of growth of civilization.

In support of my contention that Emmet was interested in things outside of his engineering work, and persistently undertook to contribute to many fields, I ought to mention such items as his publication on "The Formation of the Moon and Earth." This is not done to emphasize the fact that astronomers are still uncertain as to the relative contributions of volcanoes and falling meteors to the Earth or the Moon. They recognize falling bodies as contributing to the pock-marked moon-face, as Emmet suggested. But it was typical of him to select this subject for a Fortnightly Club address, where discussible papers were most desired. It was typical also that he had noticed that many of the Moon's "craters" looked more like spattered mud-holes than like extinct volcanoes. Most of us see in such cases about what the experts say they see. But Emmet usually looked for more. He knew about the Great Meteor Lake in Arizona and reasoned that meteors were not always few or isolated cases. Why should not at the proper time, such falling bodies somewhat disfigure the face of the moon? Such ideas, acquired from thinking independently, and about "first causes," gave him interesting views of geology and cosmic actions, so, at his own expense, he published the above mentioned paper, which was later printed in The Scientific Monthly. The effects of such efforts, when based on observation, make people think and that was his aim. A written reference to this is also interesting: "To this moon and earth theory, which is only in part original with me, I have given a good deal of study and I think my ideas are valuable."

Here is another example of the way he actually worked. Any new undertaking usually involves some risk. It has the peculiarity that not all its dependent parts can be found at the beginning. Some essential portions must be sought and discovered. This calls for faith. Judgment and reason testify that much yet unknown always responds to new effort. It is a bold engineer who does not put safety first, but how may one know just how far to depend upon future discovery to insure his new ideas? In case of the mercury boiler, Emmet had left as little to chance as possible, but it was not realized that there would be an actual dissolving action of mercury on steel. Everyone knew that mercury was kept indefinitely in iron containers. Nevertheless at the temperature of preferred design, he discovered a low rate of solution of the iron. This meant possible ultimate loss of valuable mercury from holes eaten through the hottest part of the boiler. Emmet's planning now showed his skill. He called for a detecting device which would show the slightest trace of escaping mecury in the stack-gases. The device had to be more sensitive than any existing means. Several types were then invented and so arranged that the slightest leak would start the operation of warning and shut-down apparatus. Meanwhile a different group of experts was asked to devise means of preventing this dissolving action. For this he chose "Tony" Nerad, a research man after his own heart. With various hypotheses they made countless experiments. Any hypothesis, if tangible, was forcefully applied. Many such had to be abandoned. Finally a certain mixture of very small quantities of rare metals proved the boiler life-saver. No one could have safely predicted this result, and few could explain it when it was proved. My point is that the attempts were a part of Emmet's risking and persisting technique.

After he had experienced the uncertainties of early years, and had begun devoting his unusual energies to the electrical field, he still spent himself generously upon many of the details of the rapidly expanding work. But consistently he seemed to be planning for some distant future. Everything which could simplify electrical applications was of interest to him. Every new suggestion for increased economy appealed to him. In mid-life he had applied himself to the pressing needs of current problems, gradually he extended himself into the future possibilities. He never stopped trying to find methods which might give more electrical energy "per pound of coal." His path is clear as he went from lighting and railway applications through steam and water-power generation to the entirely new applications. His foresight also included the development of his assistants and of other young engineers generally, as though he saw those unlimited fields of mechanical futures which our growing sciences make certain. His electric drive for ships was one step, but his mind saw others more promising and more difficult. When he was only part way through work on mercury boilers and turbines for the largest power-stations, he had tempting visions of mercury boilers on locomotives and in ships. The possible physical and electrical dimensions seemed to promise well in such fields. It was thus, to him, but a natural step to mercury-power in aeroplanes. He was guided by the outstanding fact that (other things equal) the greater the differences between the temperature of boiling and that of practical condensing, the greater the efficiency of a boiler. Mercury was "compact," need never be lost, could be boiled at any temperature that metals could stand, etc. Perhaps his incompleted visions will appeal to others later, but it was natural that he should have had them. He had many other visions in old age without having been called "visionary." He based his views on facts he knew something about, and he hoped obstructions either of men or materials could be removed by sufficient effort.

Thus his latest efforts were mostly directed toward lowering the cost of "prime electric power." It was a problem worthy of his metal. To the company for which he worked, it was no secret that new uses beyond the original ones of Edison (incandescent lighting) began to make the cost of lighting quite negligible. Every farm-house and barn, every city-home could be economically lighted. But how and where might the applications of power which was so conveniently carried by wires do a better job? This has been a constant problem. It attracted the individualist, Emmet, and was his final worth-while life-work. The larger the power plant (generally) the cheaper the power per unit. The more differing useful devices "on the line," the more the cost per item could be reduced. For many items, the service became practically costless but priceless, after the wires were in. The radio, home-movie, furnace-control, door-bells, clocks, etc., need current, but consume so little as to be negligible. Thus with the steadily increasing applicability of the current, there was a natural desire on Emmet's part to appreciate it all. By that I mean to add to it; and so he continued to see new uses until his death at eighty-two.

From men who came closest in contact with Mr. Emmet in his life-work, I quote first from Mr. E. W. Rice. Thus he who had, through many strenuous years, supported the new and untiring efforts of his leading engineer (a most unpeaceful job) could later write: "I became acquainted with Mr. Emmet about 1894 and was immediately impressed with his character and peculiar ability. Those who know him best have found, behind the determined demeanor, the fierce love of truth, the hatred of cant, a wholesome lovable personality, a strong man who carries within his big body a great loving heart and who has fairly won that most precious thing in life—the love of his fellow-men."

From perhaps his closest engineering assistant, Bevis P. Coulson, Jr., the following: "Salient characteristics: untiring energy, great persistency and courage. Always in search of a reason for everything. Capable of seeing a clear mental picture of the whole problem and at the same time without neglect of the smallest detail. Capable of foreseeing the future possibilities of an engineering project. Best judge of character and ability of men I have ever known. Never tired of thinking and repeatedly saying: 'It is thinking that counts.' Persisted in promoting only engineering projects that he knew to be worthwhile. Capable of aptly expressing his views. Always glad to discuss his problem with anyone who was interested. Did not suffer fools gladly. Persisted in experimentation."

Emmet was at one time vice president of the American Institute of Electrical Engineers, also a member of the American Society of Mechanical Engineers, of the Society of Naval Architects and Marine Engineers and of the National Academy of Sciences. Both Trinity and Union Colleges gave him the honorary degree of Doctor of Science. He also received the Gold Medal of the St. Louis Exposition and the Gold Medal of the San Francisco Exposition.

In 1909 he received the Edison Medal and in 1920 the Elliot-Cresson medal of the Franklin Institute. He also received the Gold Medal of the American Society of Mechanical Engineers and in 1938 The American Society of Architects and Marine Engineers awarded him The David W. Taylor Medal.

He died at his nephew's home in Erie, Pennsylvania, September 26, 1941, and was buried with Naval Honors in the National Cemetery at Arlington.

A COMPREHENSIVE—BUT NOT COMPLETE—BIBLIOGRAPHY OF THE WRITINGS OF W. L. R. EMMET

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

Transactions

Discussion: Marine steam turbine development and design. Vol. 13, pp. 278-80, 1905.

Application of electricity to propulsion of naval vessels. Vol. 17, pp. 197-222, 1909.

Discussion: The best arrangement for combined reciprocating and turbine engines on steamships. Vol. 19, pp. 206-07, 1911.

Automatic record of propeller action in an electrically propelled vessel. Vol. 19, pp. 255-57, 1911.

Discussion: Engineering progress in the U. S. Navy. Vol. 20, pp. 75-77, 1912.

Discussion: An electrically propelled fireproof passenger steamer. Vol. 20, pp. 187-90, 1912.

Electric propulsion of U. S. S. *Jupiter*. Vol. 21, pp. 191-200, 1913.

Discussion: The applicability of electric propulsion to battleships together with the experience gained with it on the *Jupiter*. Vol. 22, pp. 198-201, 1914.

Some comparisons relating to electric propulsion of a battleship. Vol. 23, pp. 71-88, 1915.

Discussion: Theory of fluid friction. Vol. 24, p. 82, 1916.

Discussion: On the suitability of the current design of submarines to the needs of the U. S. Navy. Vol. 24, pp. 120-21, 1916.

Alquist gearing for ship propulsion. Vol. 24, pp. 181-94, 1916.

Discussion: Progress in turbine ship propulsion. Vol. 26, pp. 79-80, 1918.

Discussion: The propulsive efficiency of single-screw cargo ships. Vol. 27, pp. 133-34, 1919.

Electric propulsion of merchant ships. Vol. 27, pp. 277-99, 1919.

Discussion: Electric propulsion of ships. Vol. 29, pp. 123-25, 1921.

Discussion: The central power station goes to the sea. Vol. 36, pp. 259-60, 1928.

MARINE ENGINEERING

Ship propulsion by the mercury vapor process. Vol. 43, pp. 31-32, Jan., 1938.

A mercury propelled cargo ship. Vol. 46, p. 80, Feb., 1941.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—PUBLICATIONS

Journal

Electric propulsion of ships. Vol. 34, p. 373, 1912.

Mechanical Engineering

Emmet mercury vapor process. Vol. 46, p. 235, 1924.
Carnot's influence upon engineering. Vol. 57, p. 426, 1935.
Status of Emmet mercury-vapor process. Vol. 59, p. 840, 1937.
Emmet mercury process. Vol. 59, pp. 957-58, 1937.
Mercury cargo ship. Vol. 62, pp. 911-12, 1940.
Mercury vapor for central station power. Vol. 63, pp. 351-56, 1941.

Transactions

Steam turbine in modern engineering. Vol. 25, p. 1041, 1904.
Emmet mercury-vapor process. Vol. 46, p. 253, 1924.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS

Some comparisons relating to electric propulsion of a battleship (*California*). Abst. Vol. 28, p. 231, 1916.
Electric drive for merchant ships. Vol. 31, p. 541, 1919.
Development of engineering talent in the navy. Vol. 33, p. 64, 1921.

MISCELLANEOUS PERIODICALS

Why electric drive is being recognized. Naut. Gaz., Vol. 114, p. 615, 1928.
Economies of the Emmet mercury vapor process for steam and power generation. National Engr., Vol. 32, p. 261, 1928.
Diesel vs. turbo-electric drive. Shpbldg. & Shpg. Rec., Vol. 31, p. 640, 1928.
10,000 kw. mercury unit cuts fuel bills $8000 a day. Elec. World, Vol. 94, pp. 969-77, Nov. 16, 1929.
Emmet mercury vapor process—results accomplished. G. E. Review, Vol. 32, p. 619, 1929.
Results of mercury vapor cycle at Hartford. Power Plant Engr., Vol. 34, p. 378, Ap. 1, 1930.
A mercury-propelled cargo ship. Shipbldr. and Marine Engine Bldr., Vol. 48, pp. 176-78, April, 1941.

BOOKS

Alternating current wiring and distribution. New York, 1898. 96 pp.
Autobiography of an engineer. 1st ed., Albany, N. Y. Fort Orange Press, 213 pp., 1931. 2nd ed., New York, American Society of Mechanical Engineers, 1940, 226 pp.