NATIONAL ACADEMY OF SCIENCES
OF THE UNITED STATES OF AMERICA
BIOGRAPHICAL MEMOIRS
VOLUME XVIII—FOURTH MEMOIR

BIOGRAPHICAL MEMOIR

OF

JOHN JOSEPH CARTY

1861–1932

BY

FRANK B. JEWETT

PRESENTED TO THE ACADEMY AT THE AUTUMN MEETING, 1936

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By Frank B. Jewett

Henry Carty, the father of John J(oseph), emigrated to America in 1825, when eighteen years of age. He landed at Eastport, Maine, and after trying work on a nearby farm, moved on, finally reaching Cambridge, Massachusetts, where he settled and learned the machinist's trade. Here he married Elizabeth O'Malley who, like himself, was of Irish lineage. It is reported that fortune smiled rather genially upon the couple and that they became respected and comfortably well-to-do citizens of their adopted city.

John J., the fourth child of the union of Henry and Elizabeth, was born in Cambridge, April 14, 1861. During Carty's boyhood, his father operated a bell foundry. It does not appear that he evinced more interest in his father's profession than might have been shown by any normal youngster, but he did give evidence of being strongly attracted by physics, and in particular by electrical science which was then quite in its infancy. His first schooling was in the Allston Grammar School, where he had the good fortune to come under the tutelage of a G. W. Roberts, the master of the school. Viewing his youthful days in retrospect, Carty once said affectionately, almost reverently: "People like 'Donkey' Roberts don't exist nowadays; ours is the era of the chain-store fellows."

From the Allston Grammar School, Carty passed to the Cambridge Latin School, with the intention after graduation of carrying out his parents' wishes by entering Harvard College and then finishing with a course in the Law School. But the plans for making a lawyer of John J. Carty never reached fruition, although in view of the qualities of intellect he later disclosed there can be little doubt that he would have made a most brilliant and able barrister. At a critical moment, trouble developed in his eyes and became so acute that for a time he was compelled to discontinue all study. Rather than graduate behind

his old classmates, Carty, then seventeen years of age, decided to seek employment. Following his natural bent, the first job was in a shop devoted to the sale of, as the phrase then went, "philosophical apparatus," and of which the proprietor was one Thomas Hall. Although the atmosphere of the shop quite satisfied his youthful curiosity, his employment there was short-lived and terminated abruptly when he electroplated some old bits of brass to make them appear like gold and left them for Mr. Hall to discover.

From the scientific shop, Carty seems to have wandered quite by chance to the office of the Boston Telephone Despatch Company, where E. T. Holmes was operating a small telephone exchange as an adjunct to an already established burglar alarm system. This exchange included a switchboard for interconnecting telephone lines. After an interview with the superintendent, Carty was hired at twice his former wage to serve as one of the boy operators. Thus began his lifelong connection with the telephone business. Years afterward, speaking of the boy operators, he said that they made very poor precursors to the girls; "They were not old enough to be talked to like men, and they were not young enough to be spanked like children."

Carty's service with the Boston Telephone Despatch Company and with the New England Telephone and Telegraph Company continued from 1879 to 1887. He soon passed from the ranks of the boy operators to work involving design, construction and maintenance, and he early showed facility at finding ways to improve the primitive, almost naive, apparatus and methods which characterized the earliest years of the telephone art. One of his outstanding contributions, made in 1881, was the application to commercial use of the full metallic circuit instead of the single grounded wire which had been previously used and which had been borrowed from the telegraph art as it then existed. It was also at this time that Carty laid the foundation of what was later to become the common battery telephone system. This momentous development required several years to perfect, however, and his most valuable inventions pertaining to it did not arise for another decade.

A complete list of Carty's patents comprises twenty-four in all, which were issued in the period between 1883 and 1896. There were other inventors whose contributions to the telephone art were more numerous than Carty's, but no contemporary excelled him in the importance of his inventions; for example, his common battery switchboard, his bridging bell and his transformer or repeating coil type of phantom circuit are as fundamental to the telephone art of today as they were forty years ago.

In 1887, Carty left Boston and the New England Telephone and Telegraph Company to take charge of the telephone cable department of the Western Electric Company with headquarters in New York. His genius appears to have been too many-sided, however, for him to remain long in this rather specialized work. From the cable department he passed to the switchboard department and then, in November of 1889, was appointed "Electrician" of the Metropolitan Telephone and Telegraph Company, now the New York Telephone Company. Thus, in his twenty-eighth year, he stood as the technical chief of what was then the greatest telephone system in any city in the world.

Had Carty's contributions to the communications art extended no further than the inventions and developments just noted, he would have lived and been remembered today as one of the greatest of telephone engineers, but his genius was as remarkable for its power to visualize the needs and possibilities of the future as to solve particular problems once they had arisen in concrete form. He not only foresaw that the business was destined to be an extremely technical one but had the courage to act upon this vision and build up a scientific department years in advance of the time when it became the practice of the industry to employ trained scientists and investigators. More than this, he conceived one of the functions of his engineering department to be that of a training school for the men who would later become officials of the company. Carty was, therefore, one of the early initiators of industrial research and one of its most ardent advocates. During his long career as Chief Engineer of the American Telephone and Telegraph Company and later as

Vice President, he brought into being what is thus far the world's largest industrial research organization, an organization which through his wise leadership rapidly placed the United States as the foremost nation in matters telephonic.

In reviewing the outstanding activities of Carty's life, one is tempted to say that they all sprang from a single guiding principle or motif, namely, a passionate belief in the value of the communion of mind with mind and the smooth collectivity of action which would in time arise therefrom. Such a motif accounts, of course, for the fact that he dedicated himself without reserve to the telephone and its future. It accounts equally for the type of research organization which he built up to insure the materialization of the future of which he dreamed. Even from the days of his earliest association with it, he seems to have entertained a firm conviction that the telephone was destined to make possible a nation-wide transmission of speech. To his maturer mind, such a far-flung network of telephone lines became more than an arrangement for exchanging conversations. He thought of it as a national nervous system, binding the people and the geographical units of the country together and serving indispensably that collectivity of action which is the ultimate goal of superorganic evolution.

In the importance which Carty attached to human cooperation, he was a true disciple of Herbert Spencer. He knew that in human society, the whole is much greater than the sum of its parts; that individuals by themselves could never reach the same high level of output, either intellectually or materially, that could characterize the group under harmonious cooperation. It was from this standpoint that he appraised the research organization he had brought into existence. To him it was more than a group of individuals,—it was a sort of collective mind which, made up of experts in many fields who collaborated continually with one another, could arrive quickly at the solutions of problems so intricate in their ramifications as to require years of single-handed effort, if indeed they could be solved at all single-handed. Such research organizations Carty constantly advocated in his public addresses as one of the most important contributions of

our age to the progress of mankind. He in turn seemed to obtain a double satisfaction from the fact that the laboratory—the collective research mind—whose work he directed was developing a nervous system for the nation as a whole, so that it in turn might function more smoothly as a well-integrated organism and reach that higher goal which represents perfectly coordinated cooperative effort.

This is the theme which Carty promised himself he would elaborate after retirement from active service. Unfortunately, an untimely death prevented. As matters stand, it finds scant place in any of his writings for these were usually directed to an immediate end, and the pressure of his life was such that he economized words on every occasion. A few brief paragraphs taken from his address, "Science and the Social Organism," delivered in celebration of the twenty-fifth anniversary of the Cold Spring Harbor Laboratory of the Carnegie Institution, are, however, worth noting here.

"The awful spectacle of the increasing numbers of the mentally sick, the prevalence of nervous diseases, and the generally disturbed condition of the nations, have caused many to believe that we are headed in the wrong direction, and that our ideals should be those of the so-called simple life, or that we should seek to attain to the static condition of ancient China. Were it not for my faith in the ultimate success of such researches as you are conducting in this institution, I believe that I, too, would share these views and be inclined to the opinion that in merely material progress we had gone far enough—perhaps too far, or too fast.

"While I have frequently asserted that human behavior presents the most important and the most formidable problem of all the ages, I believe that its solution can be achieved. . . .

"To me, this celebration today is an event of the deepest significance, for it indicates the beginning of a new era of social development. As Trotter* so well puts it:

" 'The method of leaving the development of society to the confused welter of forces which prevail within it is now at last reduced to absurdity by the unmistakable teaching of events. The conscious direction of man's destiny is plainly indicated by

* W. Trotter.—Instincts of the Herd in Peace and War.

Nature as the only mechanism by which the social life of so complex an animal can be guaranteed against disaster and brought to yield its full possibilities.

" 'A gregarious unit informed by conscious direction represents a biological mechanism of a wholly new type, a stage of advance in the evolutionary process capable of consolidating the supremacy of man and carrying to its full extent the development of his social instincts.'

"Human progress need no longer be left solely to chance. By the aid of science, it can be brought under our conscious control.

"In concluding, let me say that if we rightly interpret the work of these scientists which we are briefly to examine today, we shall find that it is directed ultimately to the overcoming of the defects both of body and mind which are found in the individual man, and which now prevent him from properly performing his function as a member of society. We shall also, I think, be made to feel that in the great plan of creation, the highest part has been assigned to man; for he must direct the development of that social organism which has been foreshadowed 'with its million-minded knowledge and power, to which no barrier will be insurmountable, no gulf impassable and no task too great.' "

For some years after Carty assumed administrative work, he still found time to indulge his strong natural bent for original investigation. It was in this period that he carried on his fundamental researches regarding the nature of the electrical induction between parallel circuits which, in telephone parlance, gives rise to "crosstalk," i.e., to the transfer of part of the speech energy from one circuit to another parallel to it. It had been commonly supposed that the induction was largely electromagnetic. Carty was able to prove that it was, on the contrary, largely electrostatic. In 1889 he published an account of this work, pointing out that "there is in the telephone line a particular point at which, if a telephone instrument be inserted, no crosstalk will be overheard." He gives directions for determining the location of this neutral point, and goes on to develop the ideas of electrical balance and the transposing of circuits—two operations which are of fundamental importance in the art today. From this period there also came his contribution of the bridging bell, a circuit which he was forced to evolve to meet an embarrassing contract into which his company had entered with the New York

Central Railroad to supply them with a multiparty private line, but which rapidly found widespread use in a multitude of rural lines all over the country.

It is an interesting side-light on Carty's fecundity of mind that during this strenuous period when he was guiding the engineering and research activities of an adolescent telephone industry and organizing and building up the nucleus of what was later to become the Bell Telephone Laboratories, and was indeed personally leading the attack on many problems, he found time to write regularly for the *Electrical Review*. These contributions were known as "The Prophet's Column" and appear to have supplied him a sort of mental relaxation—he seldom, if ever, resorted to physical exercise as a means of relaxation. His discussions were usually in the lighter vein and offered the opportunity of mixing mild doses of scientific information with a leavening of humor, for, true to his Irish ancestry, he had an inexhaustible store of the latter continually bubbling up for release. A single quotation will serve by way of illustration.

"The man who could have bought Bell Telephone stock at $10 a share and didn't is now becoming extinct. His favorite haunt was the smoking compartment of a Pullman car, where he was wont to repeat the oft-told tale of the grocer who did and got it in payment of a bad debt at that. In his place we have another specimen quite as easy to recognize. After some of the strange tales of electrical science have been discussed, he is sure to gravely remark, as though it had never been uttered before, 'Well, electricity is in its infancy,' and quickly add the inevitable corollary, 'but it's the coming power, though.'

"Just watch this man. You will be surprised to see how many there are of him. He is the Public. You must study his moods and lead him aright. The marvelous products of electrical science have so charmed his mind that no story of its newly discovered powers can be so much at variance with the laws of nature as not to be received by him with ready belief."

In 1893, Carty was elected an Honorary Fellow of the American Electrotherapeutic Association, in recognition of his success in the self-imposed task of rationalizing the electrical terminology of the medical profession of that day. He inveighed strongly against such puzzling and nonsensical terms as Farad-

ism, Franklinism and Galvanism and a host of others, submitting to medical men an earnest plea for the revision of their electrical nomenclature in accordance with the language of physics. Thus we see again clear evidence of Carty's insistence on clarity of thought.

As the prime requirement of a leader is accuracy of thought and clearness of vision, it is worth quoting at some length from Carty's paper of 1906 entitled "Telephone Engineering" delivered before the American Institute of Electrical Engineers. It is a lucid exposition of the responsibilities of the telephone engineer or, with proper changes in terminology, of the engineer in general. In closing this paper, he said:

"From beginning to end, the engineer is thus placed in a position to exercise a veto power upon any adverse methods which might otherwise be allowed to creep in. . . .

"The importance of this coordinating function cannot be overestimated and it is only at some central point that such function can be exercised. Being judged from the maintenance point of view, a piece of apparatus might have qualities of a high order; but when considered with reference to its effect upon the traffic, difficulties might be discovered which would entirely overweigh the maintenance advantages. In such a case the conflicting claims with respect to the apparatus must be judiciously considered by the engineer, and his decision must be rendered with a view to producing the best net result.

"Again, systems might be proposed which, considered solely from the maintenance, construction and traffic points of view, might seem to possess all of the advantages of an ideal arrangement; but when considered from the standpoint of the efficiency of transmission might be found to involve an impairment of transmission on one hand or such increase in cable and line costs on the other hand as to render its use out of the question.

"In order to exercise proper coordinating functions, it is essential that the engineer should be placed and should maintain himself in such relations with all of the departments of the telephone organization that he may get from them and fairly consider all of the projects and ideas pertaining to the design, operation, construction and maintenance of the plant which naturally originate in such departments when they are conducted with proper efficiency.

"Viewed from this standpoint, it will be seen that while the

function of the engineer with relation to the plant is of the utmost importance, nevertheless the work of the traffic, maintenance, construction and other departments has such an important bearing upon the whole question, that the successful engineering of a telephone system must be regarded not only as the work of the engineer himself but as the work of all of the other departments concerned. Not only this, but what is still more important, the successful engineering of a telephone plant depends upon proper business management, as I have indicated by several striking examples. Without an intelligent, progressive and broad-gauged business management, there cannot be good telephone engineering."

In 1908, Carty, who had become Chief Engineer of the American Telephone and Telegraph Company in 1907, visited the Pacific coast to assist the local telephone officials in formulating plans for rebuilding and enlarging the telephone plant. He was accompanied by some of his assistants and was joined later by T. N. Vail, then President of the American Telephone and Telegraph Company. San Francisco was in the initial stages of cleaning up the debris of earthquake and fire preparatory to building a new city and of christening it with a great international exposition.

The hardihood and daring of the program appealed to both Vail and Carty, as did the urgent demand of the citizens, that the Pacific and Atlantic coasts be linked telephonically by the time the job was done. To Carty, accustomed as he was to daily talks with associates even though hundreds of miles away, the sense of remoteness caused by this western trip was oppressive. As he observed with a twinkle in his eye to a native son of California, he "was greatly impressed with the isolation of the rest of the country."

However, to promise meant to fulfill and how could more than three thousand miles of distance be spanned telephonically when the existing art had conquered even poorly but half that distance? Night after night, for weeks on end, after hard days on current problems, Carty and two or three of his associates spent evenings in their hotel among the ruins analysing the possibilities of an unconquered future. Finally the chances of suc-

cess were established to Carty's satisfaction and the promise was given—to be sealed irrevocably next morning by glaring newspaper headlines.

Carty returned to New York to put the necessary machinery in motion for this gamble with Fate. Six years later saw the opening of the first transcontinental wire line, and a few months afterward, using very nearly the same instrumentalities, he was able to announce the first successful transmission of the voice by radio telephone across the Atlantic and also across the American continent and as far out into the Pacific as Honolulu. During these six years, Carty was at the apex of his powers. He drove himself and his associates with a force that was untiring and unsparing. Sleep and relaxation in small doses were grudgingly accorded. For the rest it was unceasing labor with the success of the organization, which was his life, and the good of the nation he loved, as the goal.

Both the opening of the transcontinental telephone line and the first transmission of speech by radio to Paris occurred in 1915 after the outbreak of the World War. The military importance of the enormous extension of the scope of telephony which these two events signalized led General McComb, President of the Army War College, to invite Carty to deliver a confidential lecture before that body on "The Organization, Plant and Personnel of the Bell System." This lecture was repeated a few weeks later before the Naval War College. From these two appearances there followed a series of events leading up to the subsequent extensive utilization of the facilities of the Bell System by the Army and Navy. There was springing up in high places a very definite realization of the military importance of the latest telephone developments, and a belief that the research facilities of the Bell Telephone organization could probably contribute still other new devices of value in the national defense, in case the United States were forced into the hostilities. The Honorable Josephus Daniels, Secretary of the Navy, wrote to T. N. Vail, President of the American Telephone and Telegraph Company, "appealing to the patriotic sense of this Company" and inquiring whether it was in a position to give the Navy De-

partment "a demonstration of what could be accomplished in the way of communication, particularly in long distance telephony and telegraphy, which would bring the offices of the Department and the Navy Yards and Stations within the limits of the United States proper into that close touch which the exigencies of war might demand."

"In order that this mobilization of forces of communication may be complete, and recalling the close cooperation of officials of the Department in the past with the officials of your Company in the development of the wireless telephone, it is confidently hoped that its use as a means of communication with a ship at sea could also be demonstrated at the same time under such conditions as might be mutually agreed upon." The Secretary added, "Congress provides no funds whereby the expense of such a demonstration could be borne by the Government and thereby recognizes that whatever is done by your Company will have to be free of all expense to the Department."

The cooperation of Carty and his research staff to this request and similar ones from the Signal Corps of the Army was immediately forthcoming, and among other contributions there should be mentioned particularly a sturdy radio telephone outfit that was extensively used on aircraft and on destroyers and submarine chasers. The American Army, of all those in the field, alone was able to avail itself of the aid of radio telephony.

But Carty, ever mindful of the personnel side of every situation, realized that physical things alone would not suffice. To be effective they must be in the hands of a properly qualified operating organization. Thus, while on the one hand, he brought to the administration at Washington a realization of what the telephone art and the telephone organization could offer, he also arranged a complete plan of action with the executives of the Bell organization. Addressing a conference of Presidents of the companies comprising the Bell System, he said:

"Our plans contemplate two classes of Signal Corps officers to be recruited from the Bell System. One of these is to consist of engineers and executives who will remain in their offices,—representing the War Department and taking their orders direct

from Washington. Their duty will be to direct the highest possible military utilization of the Bell System plant and personnel, without at the same time crippling the service as a whole.

"The other group will consist also of executives and engineers, who will select and organize the trained personnel of the Bell System into companies and battalions, for such field service as occasion may require. I cannot, of course, take final steps in this vital programme without your support. I now ask that support. We must act as a unit."

Again Carty's foresight and his forceful call to action were vindicated. When war was declared with Germany, the entire Signal Corps personnel, including men in the field as well as a small group at headquarters, consisted of 55 officers and 1570 men. Within a few months, this nuclear organization was swelled by 4525 persons taken out of the Bell System alone.

Then the question arose as to how to equip the Army shortly to depart for France. The military type of telephone and telegraph apparatus theretofore employed was simple in design, sturdy in construction, and not easily put out of order, but its capabilities were extremely limited in comparison with the latest results which the commercial system in the United States was obtaining. The new apparatus was complicated and delicate, and the unfavorable conditions of warfare would tax it in a manner never experienced before. Should Carty, to whom the Army had turned for guidance, recommend that our Army be provided with such a modern communication system capable of furnishing a service virtually unlimited both as to message carrying capacity and as to distance, or should he recommend the traditional Army equipment? It was a vital decision. He had confidence that the men he would send to France could make a success of the system employing the newly developed telephonic repeaters and utilizing the latest type of multiplex printing telegraph apparatus. Weighing the factors involved, he concluded that the advantages of modern equipment were too great to be disregarded, and with what success the following quotations will indicate. Speaking after the war was over, before the Committee on Military Affairs of the House of Representatives, he said:

"There had been preparations made for war in the European terrain for forty years. When the war broke it was not possible for any of the European nations to provide a communication system adequate for the conduct of the war. It remained for the Signal Corps of the U. S. Army in nine months to construct a long distance telegraph and telephone system which the Governments of Europe had failed to do in forty years."

For the first time, it became possible to talk from Paris to Rome, and from Marseilles in the south to Le Havre, and even across the Channel to London and Liverpool. And, following the Armistice, Colonel (later General) Saltzman, Acting Chief Signal Officer of the Army, wrote Carty, saying:

"In the operations in France, our Army has enjoyed a wonderful system of communication of an efficiency and capacity never before contemplated in the history of warfare. In considering the initial conception and the successful operation of this system, the Signal Corps will ever remember your splendid foresight and the technical efficiency of the thousands of trained men that you brought into the service. It would be very difficult to place a value on the services which you have rendered to our country in this connection alone."

In recognition of his service during the war, Carty was on October 23, 1921, created a Brigadier General in the Officers' Reserve Corps.

Following the cessation of hostilities, Carty again returned to the commercial and social aspects of the telephone. Always in the background of his thoughts was the idea of adapting the telephone more and more fully and intimately to the needs of the country, so that to the greatest extent possible it could play its part in facilitating harmony of action. A memorable instance of this occurred at the burial of the Unknown Soldier in Arlington Cemetery, November 11, 1921. Realizing the dramatic possibilities inherent in the ceremony, he offered to the administration in Washington the nation-wide use of the public address system which had but recently emanated from the telephone laboratories. His offer was accepted and circuits, amplifiers and loud speakers were so arranged that thousands of people in New York and San Francisco as well as in Washington heard and

participated in the entire service—the invocation of the chaplain, the words of the commitment—and finally, at the close, joined with the President in reciting the Lord's Prayer.

So rapidly have events moved in the field of electrical communication that it is difficult now to realize that at that time, scarcely fifteen years ago, radio broadcasting was an unknown development. At the burial ceremony, the entire transmission was by wire telephone lines, and the multitudes who heard were of necessity gathered within earshot of powerful loud speakers—in Madison Square and Madison Square Garden in New York and in the great Civic Plaza in San Francisco. In a very real sense, as we look back upon this outstanding occasion, it may be said that Carty was the father of broadcasting. Today, the local distribution of programs takes place by radio while, as in that occurrence, the broadcasting stations themselves are tied together by long distance telephone circuits. Radio stations together with receiving sets in the hands of the public have displaced Carty's powerful loud speakers but not the nation-wide network of long distance wire lines. On a somewhat similar occasion in February, 1924, after radio broadcasting had appeared, Carty connected seven large broadcasting stations by a telephone circuit extending from San Francisco to Havana, a distance of more than five thousand miles. This constituted a forerunner of chain broadcasting as we know it today, and newspapers at the time estimated that no less than fifty million radio listeners heard the program, which comprised portions originating at several points along the route. Carty himself remarked:

"We are only just beginning to appreciate how fundamental are electrical communications in the organization of society. We are as yet unable to appreciate how vital they are to the ultimate welfare of mankind. I believe that some day we will build up a great world telephone system,—which will join all the people of the earth into one brotherhood."

This was the goal for which he worked unremittingly and the later years of his life enabled him in large measure to provide the material accessories necessary to the realization of his vision.

Just fifty years after the invention of the telephone, the first two-way conversation was heard across the Atlantic Ocean, and the year following regular commercial service with England was begun. Beginning with this single overseas circuit, progress became so rapid that now it is possible for any telephone anywhere in the United States to be connected with about ninety-eight per cent of all the telephones in the world.

For some years, of course, Carty had made no technical contributions to this epic of progress, but his was the vision and the generalship which on the one hand created an engineering and scientific organization capable of solving the countless problems involved, and on the other convinced those who held the purse-strings that the financial risk they were taking was one which some day they would be very grateful for having taken.

In the case of one who was as firm a believer in the value of scientific research, both fundamental and applied, and who was so successful in inspiring it as Carty, it is not surprising that his counsel was frequently sought by others and that he undertook a considerable amount of proselytizing. Most of the addresses which he gave during the later years of his life were devoted to pointing out the benefits which the world had reaped by the industrial application of science and to evaluating these benefits both in terms of human comfort and conveniences and in terms of money. These addresses contain characteristic phrases and similes. Carty always took delight in coining a new one, but the old ones were seldom discarded. Thus, "Science and the Industries," which was given before the National Research Council, February 6, 1920, contains an allusion to the North American Indian. Referring to the rapid strides which science had been making in recent decades, he pictured "future generations looking back upon us with our present limited knowledge of the forces of Nature as we now regard the North American Indian who, cold and shivering in his scanty clothing, was ignorant of the coal at his feet with its stores of warmth and power." To this Indian, Carty frequently and jocularly referred as his "star performer."

In many other ways, Carty fostered the interests of science, both at home and throughout the world. In 1923, he was elected to the Board of Trustees of the Carnegie Corporation. He was a Trustee of the Carnegie Institution of Washington; an Associate of the Council of New York University; a Fellow of the American Academy of Arts and Sciences; and a member of the National Academy of Sciences and of the National Research Council.

Carty's intense devotion to the National Academy of Sciences and the National Research Council was typical both of his broad interests and of his penetrating understanding of the power existing in institutions founded solidly on a broad base properly related to its surroundings. That he enjoyed the intellectual and personal contacts which these associations afforded was self-evident. They were, however, secondary to his interest in the continuing constructive influence which the Academy and Council could exert on the proper development of the nation. He gloried in the simple national charter of the Academy because he saw in it an instrument of great power. He was disdainful of all that savored of making the Academy merely a home for established scientific reputations—it could hardly escape being that but in his eyes it must be a tool by which science could aid the nation to a better way of living.

With the passing of Dr. John J. Carty on December 27, 1932, the telephone industry lost its foremost artificer and seer, the engineering fraternity one of its keenest minded members, and the American nation a most devoted patriot and champion. The far-flung and highly developed telephone service of the United States today is in large measure the outward embodiment of the imagination and creative power of Carty's mind.

The following honorary degrees had been conferred upon him:

Doctor of Engineering: New York University, Stevens Institute of Technology.

Doctor of Laws: McGill University, University of Pennsylvania.

Doctor of Sciences: Bowdoin College, Princeton University, Tufts College, University of Chicago, Yale University.

For the active part which he took in assisting the U. S. Signal Corps during the war, he was awarded the Distinguished Service Medal. He also received the Edison Medal of the American Institute of Electrical Engineers; the Franklin Medal of the Franklin Institute; the John Fritz Medal; and the Edward Longstreth Medal.

A list of his published writings and addresses is given in the following appendix.

APPENDIX

LIST OF JOHN J. CARTY'S PUBLISHED WRITINGS AND ADDRESSES

Interview, "The Telephone: An Improved Switchboard Introduced by the New England Co." Boston Daily Advertiser, Feb. 22, 1885.

"The Multiple System of Switchboards." Paper presented before the National Telephone Exchange Association, Sept. 10, 1885. Proceedings, National Telephone Exchange Association, 1885; Electrical World, Sept. 19, 1885.

Editorial, "The Danger of Gas in Underground Work." Electrical Review, N. Y., Feb. 9, 1889.

Editorial, "Security Against Disturbances of Ships' Compasses. The Effect of Electric Light Apparatus on Ships' Compasses." Electrical Review, N. Y., June 22, 1889.

Letter to the Editor of the Electrical Review, "Long Distance Telephoning—Electric Cars." Electrical Review, N. Y., Aug. 31, 1889.

Editorial, "The King of Spain and the Exposition." Electrical Review, N. Y., Aug. 31, 1889.

"The New Era in Telephony." Paper by J. J. Carty, A. S. Hibbard and F. A. Pickernell, presented before the National Telephone Exchange Association, Sept. 1, 1889. Proceedings, National Telephone Exchange Association, 1889; Electrical World, Sept. 21, 1889.

"A New View of Telephone Induction." Paper presented before the Electric Club, N. Y., Nov. 21, 1889. Electrical Review, N. Y., Nov. 30, 1889; Electrical World, Nov. 30, 1889.

"Telephone Engineering." Paper presented before the New York Electrical Society, May 15, 1890. Electrical Review, N. Y., May 24, 1890.

"Bridging Bells." Paper presented before the National Telephone Exchange Association, Sept. 10, 1890. Proceedings, National Telephone Exchange Association, 1890.

"Inductive Disturbances in Telephone Circuits." Paper presented before the American Institute of Electrical Engineers, Mar. 17, 1891. A.I.E.E. Transactions, Vol. 8, p. 99.

"The Prophet's Column." Articles appearing anonymously in the Electrical Review, N. Y., from Apr. 4 to Nov. 21, 1891.

Editorial, "Progress in Telephony," and article, "Moving a Telephone Exchange." Based on an interview with J. J. Carty. Electrical Review, N. Y., July 4, 1891.

"Sun Spots and the Weather." Editorial article reviewed by J. J. Carty. Electrical Review, N. Y., July 4, 1891.

"Is Electricity Related to Nervous Force?" Electrical Review, N. Y., Feb. 20, 1892.

"The Common Battery System." Address before the New York Electrical Society in 1902. Electrical Review, Feb. 22, 1902.

"Telephone Engineering." Paper presented before the American Institute of Electrical Engineers, Feb. 23, 1906. A.I.E.E. Transactions, Vol. 25, p. 81.

Talk before the Nashville Telephone Society, Nashville, Tenn., May 18, 1909. Cumberland Telephone Journal, June, 1909.

Address before the New England Telephone Society, June 14, 1910. New England Telephone Topics, June, 1910.

"Telephone Service in America." Address before the International Conference of European Telephone and Telegraph Administrations, held at the Sorbonne, Paris, Sept. 4-11, 1910. Proceedings, International Telephone and Telegraph Conf., Vol. 1, p. 157; Electrical Review, N. Y., Oct. 15, 1910.

"Long Distance Telephony." Address before the International Conference of European Telephone and Telegraph Administrations, held at the Sorbonne, Paris, Sept. 4-11, 1910. Telephone Engineer, October, 1910; Electrician, London, Oct. 21, 28, Nov. 4, 11, 1910.

"Long Distance Telephony in America." Paper read at the Second International Conference of Telephone and Telegraph Administrations, held in Paris in 1911. Telephone Engineer, March, 1911.

"Philadelphia and the Development of the Telephone." Paper read before the Philadelphia Section of the National Electric Light Association, March 18, 1912. Current News, April, 1912.

"Pioneer Engineering." Address at the Second Annual Convention of the Telephone Pioneers of America, N. Y., Oct., 1912. Proceedings, Telephone Pioneers of America, 1912.

Statement on the opening of the transcontinental telephone line, New York to San Francisco, Jan. 25, 1915. Telephone Review, Triumph of Science edition.

"The Status of the Engineer." Paper read at the Symposium at the Convention of the American Institute of Electrical Engineers, Feb. 17, 1915. A.I.E.E. Transactions, Vol. 34, p. 327.

Address at the presentation of the Edison Medal to Dr. Alexander Graham Bell, May 18, 1915. A.I.E.E. Pamphlet.

Address as President of the American Institute of Electrical Engineers at the banquet of the International Engineering Congress, San Francisco, Sept. 24, 1915. A.I.E.E. Transactions, Index Volume, p. 104.

Interview, in the San Francisco Bulletin, October 5, 1915, on the occasion of the radiotelephone demonstration.

Interview, in the Chicago Herald, October 24, 1915, on the occasion of the radiotelephone demonstration.

Address at the dinner in his honor at the Lotos Club, N. Y., Nov. 27, 1915. Published in "Modern Eloquence" volumes.

"The Outlook for the Work of the A.I.E.E." Electrical World, Jan. 1, 1916.

Address at the dinner of the National Geographic Society, Washington, D. C., Mar. 7, 1916. National Geographic Magazine, March, 1916.

Address before the New England Telephone Society, Apr. 19, 1916. New England Telephone Topics, May, 1916.

Address at the banquet of the Boston City Club, April 20, 1916. New England Telephone Topics, May, 1916.

Communication, as President, to the membership of the American Institute of Electrical Engineers, April 20, 1916, on the subject of industrial preparedness for national defense. Printed by the A.I.E.E. in letter form.

Address at the National Meeting of the American Institute of Electrical Engineers held simultaneously in New York, Boston, Philadelphia, Atlanta, Chicago and San Francisco, by means of the long distance telephone, May 16, 1916. A.I.E.E. Proceedings, Vol. 35, Pt. 1, p. 139; Telephone Review, June, 1916.

"The Telephone Art." Address before the Franklin Institute, Philadelphia, upon receiving the Franklin Medal, May 17, 1916. Journal, Franklin Institute, Vol. 182, p. 89; Telephone Review, June, 1916.

Address at the dinner in his honor by the Regents of the University of the State of New York, Albany, May 24, 1916. Elmira Telegram, June 5, 1916.

"The Relation of Pure Science to Industrial Research." Address as retiring President of the American Institute of Electrical Engineers, June 27, 1916. A.I.E.E. Transactions, Vol. 35, Pt. 1, p. 479; Science, Oct. 13, 1916.

Interview, by Henry N. Hall, New York World, July 23, 1916: "From Earth to the Far-away Planets by Wireless Phone."

"The Extension of the Spoken Word." Address at the 52nd Convocation of the University of the State of New York, Oct. 20, 1916. Proceedings of the 52d Convocation of the University of the State of New York, Albany, Oct. 19, 20, 1916, p. 196.

"The Wireless Telephone of the Future." A study of Chief Engineer John J. Carty, in the New York World. Telephone Engineer, November, 1916.

Address at the presentation of the Civic Forum Medal to Dr. Alexander Graham Bell, N. Y., Mar. 21, 1917. Telephone Review, May, 1917.

Address, July 25, 1917, at Camp Alfred Vail, before the 1st and 2d Telegraph Battalions, prior to their departure for France. Telephone Review, September, 1917.

Address, Oct. 8, 1917, at the Downtown Club, Newark, N. J., before the members of the 3d Telegraph Battalion. Telephone Review, November, 1917.

Address before the American Institute of Electrical Engineers, upon receiving the Edison Medal. A.I.E.E. Proceedings, June, 1918; Telephone Review, June, 1918.

"Pure Science and Industrial Research." Address at the joint meeting of the American Institute of Electrical Engineers and the American Physical Society, Philadelphia, Oct. 10, 1919. Abstract in A.I.E.E. Journal, Vol. 39, Pt. 1, p. 57.

Address at the New York Electrical League luncheon, N. Y., Nov. 12, 1919. New York Evening Sun, Nov. 12, 1919.

Statement before the Committee on Military Affairs, House of Representatives, 66th Congress, 2d Session, Jan. 28, 1920. Printed by the Government Printing Office, 1920, "Army Reorganization—Signal Corps, Hearings . . ."

"Science and the Industries." Address under the auspices of the National Research Council, Washington, D. C., Feb. 6, 1920. National Research Council Reprint and Circular No. 8.

Address at the Eighth Meeting of the Telephone Pioneers of America, St. Louis, Oct. 24, 1921. Proceedings, Telephone Pioneers of America, 1921.

"World Electrical Communications." Address before the Philadelphia Forum, Mar. 8, 1922. Philadelphia Ledger, Mar. 9, 1922; Telephone and Telegraph Age, Apr. 1, 1922.

"The Telephone's Development." Abstract of Verbal Testimony before the New York Public Service Commission, Albany, Mar. 15, 1922. Bell Telephone Quarterly, April, 1922; Telephony, Mar. 25, 1922; Literary Digest, Sept. 30, 1922.

"Achievements in Telephony." Address before the Harrisburg Radio Association, Apr. 6, 1922. Telephone News, May, 1922.

"Ideals of the Telephone Service: A Tribute to the Memory of Alexander Graham Bell." Presidential address at the Ninth Meeting of the Telephone Pioneers of America, Cleveland, O., Sept. 29, 1922. Proceedings, Telephone Pioneers of America, 1922. Bell Telephone Quarterly, October, 1922.

Address at the dinner to Assistant Secretary of War Wainwright, N. Y., Feb. 20, 1923. Information Bulletin No. 22, Office of Chief Signal Officer, Oct. 1, 1923.

"World Communications." Address before the Commercial Club of Chicago, Mar. 9, 1923. Public Service Management Magazine, April, 1923; Telephony, Mar. 17, 1923.

"Electrical Communications." Address at the meeting of the Transportation and Communications Section, United States Chamber of Commerce, N. Y., May 8, 1923. Pamphlet published by the United States Chamber of Commerce.

Address at the presentation of the Franklin Medal to General G. Ferrie, Inspector-General of Military Communications in the French Army, May 16, 1923. Journal, Franklin Institute, December, 1923.

Interview, by Merle Crowell, American Magazine, August, 1923: "Are You a Wishful Thinker?"

Address at the celebration of the 40th Anniversary of the American Institute of Electrical Engineers. A.I.E.E. Transactions, Vol. 43, p. 114.

Address at the Industrial Preparedness dinner, N. Y., Feb. 5, 1924. Army Ordnance Magazine, March-April, 1924.

Address at the dinner of the Bond Men's Club of Chicago, Feb. 8, 1924. The Ohio Bell, April, 1924; Radio Broadcast, May, 1924.

"Science and Business." Address before the United States Chamber of Commerce, Cleveland, O., May 8, 1924. National Research Council Reprint and Circular No. 55; The Transmitter, June, 1924; The Ohio Bell, June, 1924.

"Triumph of the Telephone." Electrical World, Sept. 20, 1924.

Address at the "Radio" Luncheon of the Merchants Association, N. Y., Feb. 17, 1925. Bulletin of the Merchants Association entitled "Greater New York," Feb. 23, 1925.

"The Telephotograph as an Aid to the Police." Address at the International Police Conference, N. Y., May 13, 1925. Proceedings of the 1925 Meeting of the International Police Conference, N. Y., May 12-16, 1925.

"The Semi-Centennial of the Telephone." Bell Telephone Quarterly, January, 1926; Telephony, Jan. 30, 1926.

"Episodes in Early Telephone History." Address at the luncheon of the Boston Chamber of Commerce, Mar. 11, 1926. Bell Telephone Quarterly, April, 1926; Telephone Topics, April, 1926.

Address at the Boston City Club, Apr. 15, 1926, on the 50th anniversary of the Invention of the Telephone. Telephone Topics, May, 1926.

Address at the dinner of the Algonquin Club, Boston, June 3, 1926, celebrating the establishment by Boston University of the Alexander Graham Bell Foundation to endow a Chair of Speech. Boston Evening Transcript, June 4, 1926.

Letter of appreciation written upon the occasion of the death of Charles E. Scribner. Western Electric News, August, 1926.

"Communication." Address at the 12th Session of the Congress of American Industry, Philadelphia, Sept. 15, 1926. Congress of American Industry: Discussion of Leading Authorities, Sept. 7-27, 1926.

"Procurement of Signal Communication Supplies for Military Purposes and its Relation to Industry." Military Signal Communications, Vol. I, No. 1, May, 1927, p. 6.

"Ideals of the Engineer." Address upon receiving the John Fritz Medal, Feb. 15, 1928. Science, Mar. 23, 1928; Bell Telephone Quarterly, April, 1928.

Presentation speech at the presentation of the Gold Medal of the National Institute of Social Sciences to Dr. Willis Rodney Whitney, May 3, 1928. Journal, National Institute of Social Sciences, Vol. 13, Nov. 15, 1928, p. 29.

Foreword to "Beginnings of Telephony" by Frederick L. Rhodes. Published by Harper and Brothers, New York, 1929.

"Peace and Plenty through Science." Introduction to Vol. 3 of Research Narratives, published by the Engineering Foundation, New York, 1929.

Address at the presentation of the Edison Medal to Dr. Frank B. Jewett, Jan. 30, 1929. A.I.E.E. Pamphlet "Presentation Ceremonies at the Winter Convention of the American Institute of Electrical Engineers, New York, Jan. 30, 1929."

"The Mission of the Engineer." Address at the presentation of the John Fritz Medal to President Hoover, Apr. 25, 1929. Printed in book "John Fritz Medal Presentation to Herbert Hoover, 1929," issued by the John Fritz Medal Board of Award.

"Science and the Social Organism." Address, as a member of the Board of Trustees, on the 25th anniversary of the initiation of research in the Carnegie Institution of Washington, May 31, 1929. Year Book of the Carnegie Institution of Washington, 1929; Science, Vol. 69, June 7, 1929, p. 590.

"Science and Progress in the Industries." Address at the Convention of the National Electric Light Association, Atlantic City, June 5, 1929. Electrical World, June 8, 1929.

"Science, the Soul of Prosperity." Article in the Review of Reviews, June 5, 1929, based upon the address at the Convention of the N.E.L.A.