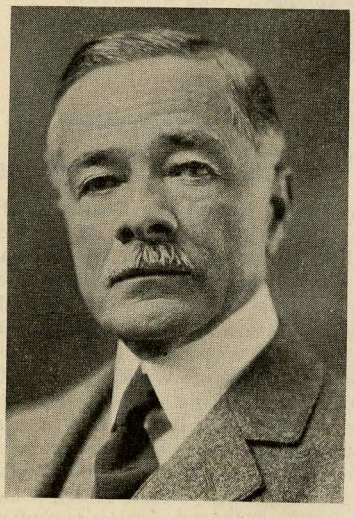
In Memoriam



JOHN J. CARTY

WHEREAS, the death on December 27, 1932, of General John J. Carty, a member of the Institute for more than forty years and an Honorary Member since 1928, removed an outstanding leader in science and its applications;

WHEREAS, through his many personal creations of important devices and methods and his extraordinary ability to analyze a problem in all its details, and to coordinate and direct the efforts of others, his achievements in the development of modern telephony, both wire and radio, became recognized throughout the world;

WHEREAS, he received high recognition for his activities in the Signal Corps of the United States Army and made other important contributions to the public service;

WHEREAS, as a member of important Institute committees, as vice-president, as a director, and as president (1915–16), he made many contributions to the development of the Institute according to the highest ideals, be it therefore

RESOLVED: That, on behalf of the membership, the board of directors of the American Institute of Electrical Engineers hereby expresses its profound sorrow at the death of General Carty, and extends its sympathy to the members of his family; be it further

RESOLVED: That these resolutions be entered in the minutes and copies be transmitted to members of his family.

Sept. 1933
Elec. Engg

OBITUARY

JOHN JOSEPH CARTY—AN APPRECIATION

WHEN in the early morning hours of Tuesday, December 27, General John J. Carty died in the Johns Hopkins Hospital, after a valiant but unsuccessful fight to overcome the shock of a major operation, the field of science, the profession of engineering and the community of intellectual life in the United States suffered a great loss. Nor was this loss confined to the nation of which he was a citizen, which he loved with that intellectual fervor which only the great possess, and which throughout his life he had served with such steadfast devotion. In many countries, from those of Europe to far-off Japan, Carty, his works and achievements and his philosophy of life were known and admired.

From every country which has felt during the past half century the stirring of that new force which science and its application has brought into human living, men have at one time or another made the pilgrimage to New York to sit at Carty's feet and to learn and profit from his wisdom. It mattered not what language the pilgrims spoke, all profited from the contact and all returned whence they came not only with a realization of this profit, but also with the realization that they had acquired the lasting friendship of a wise man.

Nor were these contacts one-sided affairs. General Carty had an insatiable desire to enlarge his own fund of information and understanding. All who came in contact with him, from the most wise to the most frivolous and shallow, were subjects for his inquiry. He gave much and willingly of his store of knowledge and wisdom but in return, and frequently in ways unknown to his vis-à-vis, he exacted payment in full measure. At times this payment was in kind; more frequently than not it was in values quite foreign to the main subject-matter of the conversation. At the termination of the contact General Carty had invariably something new added to his already great store of knowledge—a bit of social history or custom, a hitherto unknown item of science, a peculiar slant of political thinking, or any other of the thousand and one things which involve the working of human emotions or the human mind.

His relentless search into the way human beings react and into the motives which guide their thought and action, and whose results he continually marshaled and remarshaled under the guidance of his incisively analytical mind, became a main source of his extraordinary capacity for being always at home in any company. Few men possess the capacity which General Carty had for meeting on a plane of complete understanding men and women of every social and intellectual gradation. It was a capacity which enabled him in every situation to give and receive knowledge and to influence the outcome of events in ways and in a manner which were frequently uncanny.

More than most men, General Carty had at one time or another actually put himself in the position of the other man in the wide variety of situations in which men exercise their powers, their frailties, their hopes and aspirations and their emotions.

For one who attained to such eminence, whose counsel and advice were so sought after in so many fields, and whose opinion always carried such weight, even with those who dissented from his conclusions, the record of General Carty's own writings, even in the field of his profession or that part of it which was his specialized interest—electrical communication—is surprisingly meager. Of course during his long active and creative career he produced a vast volume of letters, memoranda and reports, each bearing the imprint of a master mind but each concerned primarily with some specific question of the moment. At the same time lectures, addresses and articles of the kind which go commonly to build up a reputation for wisdom and which produce a far-reaching and lasting influence were remarkably few in number. Such as do exist are almost without exception just what one would expect from their author.

Why was it that a man who possessed and deserved the reputation which General Carty acquired made so little use of the tool which most men of ability esteem their most powerful weapon? The answer is clear to those in position to know him best. In part it was because he was always too busy seeking to solve the vast array of problems crying for solution, even though he always promised himself and others that he would some time write out something of what he had learned. In part also it was because the act of authorship was for him an incredibly laborious task. Only those of us who have been witness to this labor have any real appreciation of just how difficult and time-consuming it was for him to prepare an important document which would be a permanent record of his thoughts and conclusions and to which he would be willing to sign his name. This labor was not because he in any way failed to have a perfectly definite and clear picture of just what he wished to say, nor because he lacked the full vocabulary in which to express his thoughts. Rather it was because he did have complete clarity of mind and a full vocabulary. To him words and their arrangement were powerful tools which should not be lightly nor thoughtlessly employed. Every word and every sentence in any document of importance must, when finally chosen and ar-

ranged, convey to the reader the exact shade of meaning—no more, no less—that he had in mind. This habit and insistence made serious writing far too time-consuming an operation to be indulged in frequently.

Absence of a voluminous printed record does not mean, however, that General Carty left no substantial material evidence of his great creative ability. Modern telephony, whose development owes so much to him, has in the last analysis a very limited number of elements which are prime to its existence. Some, like the telephone itself, or the loading coil or the vacuum tube amplifier, are spectacular and well known. Others of equal or greater importance have become so much the commonplace of telephone engineering that few realize their fundamental character or that their creation was ever looked upon as an outstanding achievement.

The three most important of these foundation stones which are in use wherever telephony is employed are creations of General Carty. His invention of the "common battery" for supplying operating current from a single central office battery to any number of interconnected telephones made practical the commercial development of telephony in metropolitan areas.

His development of the high resistance bridging signal bell for subscribers substations to replace the theretofore universally employed low resistance series bell, tore the hampering shackles from a wide-spread extension in the use of the telephone. Every telephone set now in use employs such a signal.

Equally revolutionary and of a more distinctly scientific character was his discovery that the principal cause of cross interference between telephone circuits was electrostatic and not electromagnetic unbalance. This discovery and the rules which General Carty worked out for the proper construction of adjacent telephone circuits are now universally employed.

A characteristic of each of these achievements is that each came as the direct and logical result of what was one of General Carty's most powerful intellectual weapons—his ability to brush aside non-essentials and grasp the kernel of the problem. Many men had worked on each of the three things just mentioned. They were obvious obstacles to progress. They yielded readily to solution once General Carty had formulated simply and accurately the essentials of the problem and the nature of the answer required.

These things and a host of others similar but less important were personal creations. They belong to his earlier years. The great achievements of his later life and for which he is best known in the field of electrical communication are the achievements of a generalissimo. Long distance telephony over land, transoceanic radio telephony, the coordination of factors which render present-day telephony so marvelously easy bear scarcely a trace of General Carty as a creator of any essential new element. They are, however, almost as surely his creations as any of his earlier work.

He analyzed the problems, picked out the essential elements to be attacked, mobilized just the right forces, provided the supplies by selling confidence in ultimate success to those who must provide the supplies and inspired a sort of fanatic determination in those who looked on him as captain.

Although primarily concerned with scientific, engineering and organization matters in the field of electrical communication and most of all in the well-being and reputation of the Bell System, General Carty looked upon the whole field of science as his hunting ground. Many of his closest friends were men of distinction in fields of science far removed from those of electrical engineering or physics. Denied the privilege of any formal training in science he nevertheless acquired such an understanding in many fields of knowledge and research that masters there sought discussion with him.

Consideration of everything General Carty did shows always the same technique. Painstaking analysis of the problem; exact formulation of the questions to be solved; full consideration of every ascertainable obstacle, human or material, likely to be encountered; assembly of just the right forces and then when all was ready a feverish onslaught quite in contrast with the slow and methodical preparations. But no matter how feverish the attack once all was ready, there was never any lessening of meticulous attention to detail where he thought that detail important. This technique he applied with infinite variations and shades to the material problems of electrical communication; to the delicate political problems involved in the daring attempt to demonstrate transatlantic telephony in the midst of the World War; to the essentially human problems of organization which created the perfect battalions which made the Signal Corps Reserve preeminent; to his part in creating the National Research Council, or to making certain that the solemn ceremonies of the burial of the Unknown Soldier should be broadcast to expectant thousands across the continent unmarred by accident.

Who but General Carty would have realized that the most probable cause of disaster in these august ceremonies would lie in forgetfulness on the part of the great participating personages under the emotional stress of the occasion? Or who but he would have known that insurance of success lay in the little piece of carpet which he himself tacked in exactly the right place where each speaker was to stand?

The lasting record of General Carty's character and

achievements is in the art of communication, of which for nearly fifty years he was an outstanding leader; in the citations by which a large number of great institutions justified their grants to him of honorary degrees or medals of distinction and in the archives of the Departments of State of his own and other nations which conferred upon him high orders in recognition of services rendered in the cause of making this world a better place in which to live.

To General Carty, science and the methods of scientific thought were never narrow things or things apart from the great problems of a fuller life. Nor were the great institutions and academies of science mere machinery for putting the capstones of acknowledged success on recognized achievement. To him their raison d'être was their unique opportunity for service.

It was in this light that he looked upon the National Academy of Sciences, an essentially undemocratic institution in a democratic country. It was knowledge of this feeling which caused his associates to create there the medal which bears his name and of which the academy later made to him its first award. It was for him the most pleasurable and satisfying token of love and esteem which those associates could render since it gave assurance of enhanced opportunity to the academy for lasting service. That he did not live to receive the medal is a source of regret to his friends. To him it mattered little.

F. B. JEWETT

SCIENTIFIC EVENTS

THE NATURAL HISTORY OF MOUNT EVEREST

IN view of the forthcoming Everest Expedition, a small selection of the specimens brought back by the expeditions of 1921, 1922 and 1924 has been arranged at the British Museum (Natural History), South Kensington, to illustrate conditions upon the mountain. According to the London *Times*, the general appearance of the upper ranges of Everest is excellently illustrated in a number of enlarged photographs. One of these shows how the high winds, even outside the seasons of the monsoon, give rise to whirling clouds of dry snow. The article in the *Times* continues:

A sectional elevation shows the altitudes up to which various forms of life were found, and objects from every department indicate the peculiarities of the natural history of the mountain. Beetles were found at a height of 16,500 feet, butterflies up to 17,000 feet, moths as far up as 18,000 feet. Each of these specimens had its idiosyncrasies; the butterflies and moths clung with their wings to the mountain side against the high wind; the beetles stiffened out and rolled; and even the ants were remarkably torpid.

The grasshoppers shown from the higher altitudes are all wingless, but are related, save for one endemic group, to winged varieties elsewhere. It is curious to note how much smaller were two specimens, within the same species, which were found at 10,000 feet, than two similar examples from the 7,000-foot level. Spiders were found above the snowline and up to 22,000 feet; they live, apparently, upon diminutive insects which themselves must exist on inconspicuous vegetable life.

Sheep were found up to 20,000 feet on the borders of the lichen-zone, but the highest recorded altitude to be reached by a mammal (20,100 feet) was attained by the Royle's pika or Wollaston's pika (mouse-hare), of which a number are on view.

In general, the fauna below 16,000 feet is of essentially the same type as that of the adjacent areas of Central and Southern Asia, while above 16,000 feet its affinities are predominantly Palearctic. The animals are, however, frequently of smaller size than their lowland relatives. The highest nesting birds were found at 17,000 feet; finches were seen migrating at 21,000 feet, and choughs followed the climbers as high as they went.

The plants found on Everest include willows, primulas, gentians, blue poppies and others known to Western gardeners. The short duration of the growing season (three to four months), the exposure to wind and cold, the brightness of the light, the pressure of snow, the distance of water from surface, the scarcity of insects and the poorness of soil, however, all help to make plant life difficult. The plants on screes and cliffs have a very long, spongy taproot, enabling them to reach down to the moisture and to resist the movement of the loose stony material.

The Himalayan range is comparatively Recent, and reached its present form only in Pliocene times. Fossil ammonites from the 14,000-foot level of the Tibetan plateau show the creatures which formerly lived in the sea, which covered the site of the great range. Examples of Recent rocks were collected up to 27,000 feet.

The exhibition, which has been arranged in the Insect Gallery by Dr. Anna B. Hastings and M. M. Burton, will remain open between six months and a year.

FORESTRY PROGRAM FOR THE SOUTH-EASTERN STATES

A FORESTRY program designed to meet the needs of the eight southeastern states has been adopted by the Southeastern Council according to an announcement made by Colonel J. W. Harrelson, director of the North Carolina State Department of Conservation and Development. This program is given below.

1. Encouragement of teaching forestry in public schools and colleges and the development of an appreciation on the part of the general public of the benefits of forest conservation.

John J. Carty

John J. Carty, telephone pioneer, whose death was announced in the December 31 issue of the ELECTRICAL WORLD, at an early age was fascinated by the possibilities of the telephone, which had recently been invented by Alexander Graham Bell, who was living

in Cambridge, Mass., Mr. Carty's native city. When an impairment of sight forced the discontinuance of his formal education, Mr. Carty entered the service of the Bell company in Boston and, with the exception of service in the U. S. Army during the World War, he had been with telephone companies in various parts of the country. In 1907 he was appointed chief engineer of the American Telephone & Telegraph Company, the parent company of the Bell System; in 1919 he was elected vice-president in charge of the department of development and research and four years later chairman of the board of directors of the Bell Telephone Laboratories, from which position he retired in 1930.

Mr. Carty's most notable achievement was the completion of the transcontinental telephone line which made possible the first transmission of speech between the Atlantic and Pacific Coasts, but he has to his credit many other attainments. Bancroft Gherardi once said: "To tell the story of his life and of his contributions is to tell a very large part of the scientific, technical and engineering development of the telephone art, not only in this country but for the whole world. . . . If we were to take out of the present telephone system those things which John J. Carty personally devised and contributed to the art, essential elements would have been removed and in many important respects the system would no longer be operative. . . ."

Among the scientific and engineering awards granted to Mr. Carty were the Edward Longstreth medal, 1903; Franklin medal, 1916; Edison medal, 1918; the John Fritz gold medal, 1928, degrees which he received in the course of his career. He was a fellow and a past-president of the American Institute of Electrical Engineers, a fellow of the New York Academy of Sciences, past-president of the New York Electrical Society and a member of the Society for the Promotion of Engineering Education, the Franklin Institute, the American Association for the Advancement of Science, the American Physical Society and other scientific associations. He was director of telephone and telegraph communications in France for the American Army, leaving the service with the title of Colonel. He was buried with military honors in Arlington National Cemetery December 29.

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ALBERT N. CONNETT, well-known engineer, who designed and built at Washington in 1895 the first successfully operated electrical conduit street railway, died January 1, of arterio-sclerosis, at his home in New York after a brief illness. He was 73 years of age. A native of Bethel, Conn., and a graduate of Rensselaer Polytechnic Institute, Mr. Connett went to Paris in 1896 as chief engineer of the Thomson-Houston Company, designing and constructing many electric surface lines in France. Four years later he became chief engineer and managing director of J. G. White & Company, Ltd., of London and in this capacity designed and built water-power plants, electric light and power plants and electric surface lines in England, on the Continent and in South America and Australia. At the time of his death he was a director of the J. G. White Engineering Corporation of New York.

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CHARLES M. EINFELDT, a member of the Board of Water Commissioners, Denver, Colo., died December 17, in that city, in his seventy-first year. A graduate electrical engineer, Mr. Einfeldt had resided in Denver since 1889 and had taken a prominent part in business and civic affairs there.

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DAVID HARLOWE, at one time a member of the Wisconsin Railroad Commission, now the Public Service Commission, died December 13 at Milwaukee. Mr. Harlowe served as a commissioner for six years and in recent years had been senior investigator of the commission.

▼

New Equipment Available

Breaker With Oil-Filled Bushings

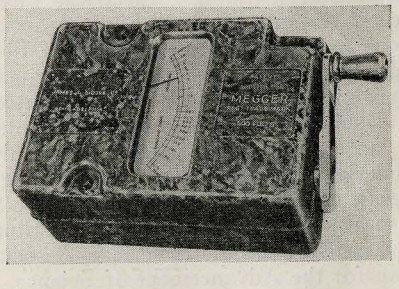
General Electric Company announces a new line of circuit breakers, rated 15, 25 and 34.5 kv. These breakers are equipped with oil-filled bushings of a new type which give the same efficient insulation and good service for potentials up to 34.5 kv. that higher-voltage oil-filled bushings have given in the past. By utilizing the oil-blast principle of circuit interruption the breakers operate in eight cycles. They are designated type FHKO-339, designed for indoor and outdoor service, and have interrupting ratings from 500,000 to 1,500,000 kva.

▼

A PORTABLE ELECTRIC HUMIDIFIER which works on the principle of internal evaporation is announced by the Westinghouse Electric & Manufacturing Company. All evaporation takes place inside the humidifier and no liquid water or free moisture comes out of the machine, consequently there is no light mist to damage or warp furniture or other objects in the room. Some of the features of this new humidifier are quietness of operation, the sound made being comparable to a Westinghouse 10-in. fan, and lightness in weight, and

Midget Megger Tester

James G. Biddle Company, Philadelphia, has announced a new midget "Megger" tester as an addition to its well-known group of Megger insulation testing sets. Some of the characteristics of this instrument are its small (pocket) size and light weight. In common with other Megger instruments, the midget Megger tester consists of a true ohmmeter, direct-reading like a voltmeter, combined with a special d.c. hand gen-



erator. The scale reads as high as 20 megohms and the generator supplies testing current at 500 volts, thus obviating necessity for depending on batteries or any outside source of current.

Special spring plunger-type terminals for rapid attachment and disconnection are provided. There are no projecting

JOHN J. CARTY

Memorial Resolutions
Adopted by the Board of Directors
of the American Institute of Electrical Engineers
January 25, 1933

WHEREAS, the death on December 27, 1932, of General John J. Carty, a member of the Institute for more than forty years and an Honorary Member since 1928, removed an outstanding leader in science and its applications;

WHEREAS, through his many personal creations of important devices and methods and his extraordinary ability to analyze a problem in all its details, and to coordinate and direct the efforts of others, his achievements in the development of modern telephony, both wire and radio, became recognized throughout the world;

WHEREAS, he received high recognition for his activities in the Signal Corps of the United States Army and made other important contributions to the public service;

WHEREAS, as a member of important Institute committees, as Vice-President, as a Director, and as President, he made many contributions to the development of the Institute according to the highest ideals, be it therefore

RESOLVED: That, on behalf of the membership, the Board of Directors of the American Institute of Electrical Engineers hereby expresses its profound sorrow at the death of General Carty, and extends its sympathy to the members of his family; be it further

RESOLVED: That these resolutions be entered in the minutes and copies be transmitted to members of his family.

National Secretary

Rec'd from
Mr H. Osborne 3/4/27 JLH

Keep in Mr Carty's file

MR. JOHN J. CARTY

Mr. Carty, now Vice-President of the American Telephone and Telegraph Company, and Chairman of the Board of Directors of the Bell Telephone Laboratories, has been famous in his field since the early days of the telephone when he was able to find the solution of a baffling problem — the mysterious noises which interfered with conversation and which apparently could not be silenced. This was but one of the difficult problems to be solved by the men who were endeavoring to prove to the general public that the new invention was not a mere scientific toy, but something destined to become of the greatest service to mankind.

John J. Carty was born in Cambridge, Massachusetts, on April 14, 1861. As a boy he had the idea that he would be a lawyer, but impaired eyesight changed his plans. He was able, however, to complete his course in the Cambridge Latin School, and in 1879 he entered the employ of the Telephone Dispatch Company of Boston, where his natural aptitude for mechanics and his love of scientific investigation attracted him to the technical side of the telephone business. Here he developed rapidly contributing many important advances in the art of telephony, among

these being the invention of a test system for multiple switchboards and the installation of the first metallic circuit multiple switchboard.

In 1889, Mr. Carty went to the New York Telephone Company, then known as the Metropolitan Telephone and Telegraph Company. Under his direction the technical foundation for the comprehensive New York telephone system was established.

When Theodore N. Vail assumed the presidency of the American Telephone and Telegraph Company in 1907, one of his first acts was to send for John J. Carty and appoint him chief engineer of the American Telephone and Telegraph Company. With a large staff of technically trained assistants, he undertook the direction of the engineering work of the Bell System. Among the many important advances made towards the realization of universal service in the Bell System under his leadership was the completion, on January 25, 1915, of the transcontinental telephone line, the fulfillment of which had been the dream of telephone engineers for almost forty years. Another was the completion of the Boston to Washington underground cable system, a distance of 450 miles and then by far the longest underground cable system in existence. Under General Carty's direction a successful demonstration of wireless telephony was made in September of 1915, when President Theodore N. Vail, at his office in New York, talked by wire to the Naval radio station in Arlington, Virginia, and thence by wireless across the continent to the Navy Yard at Mare Island, California, where General Carty, with other engineers and Naval officers,

distinctly heard and understood Mr. Vail. The next achievement of note was the establishment of wireless telephone communication from the Naval Radio Station at Arlington to the Hawaiian Islands and the Eiffel Tower in Paris, France.

The part played by John J. Carty in the World War, from which he emerged as a brigadier general in the United States Signal Officers Reserve Corps, is well known. His ability and standing as one of the greatest American engineers had long been recognized. Previous to the entrance of the United States into the World War, he had been working with officials of the Navy and had planned a mobilization of the communication forces of the United States Navy which was successfully carried out on May 6, 7, and 8, 1916. During those three days war conditions were simulated and war plans perfected which were put into practice later when the United States entered the war. Mr. Carty was offered a commission as major in the Signal Officers' Reserve Corps, which he accepted, and was commissioned on January 6, 1917. Acting in conjunction with the Chief Signal Officer of the United States Army, he then organized among the employees of the Bell System twelve battalions of trained signal corps troops and, on April 20, 1917, two weeks after the entrance of the United States into the war, Mr. Carty was called into active service and, in August of the same year he was promoted to colonel in the Signal Corps, U. S. A.

He organized the Research and Inspection Division of the American Signal Corps in France and served as chairman of the

Executive Committee of the National Research Council in America. One of his most important assignments was to prepare plans and to take the necessary steps in order to secure, at all hazards, the continuity of telegraphic communication with the American Expeditionary Forces in Europe. How successful he was in this undertaking is a matter of history which is well known to every American soldier and civilian who served in France. The task required a complete survey of the radio facilities on both sides of the ocean. In July of 1917 he was also appointed president of a board of officers assigned to an investigation of the manner and extent that the enemy countries were utilizing transatlantic electrical communication. He was also called into conference when the protocol of the Interallied Radio Commission was considered and measures discussed for the maintenance of transatlantic communication against enemy attacks. Another important phase of this transatlantic communication problem which was entrusted to John J. Carty had to do with secret codes and resulted in the development of apparatus whereby a message written in plain English could be quickly enciphered, printed in plain letters upon a page and transmitted over a telegraph line and received at a distant point where it would be copied upon a machine and appear in plain English.

General Carty was in France for ten months, having sailed on July 18, 1918. He served as Consulting Engineer for the Signal Corps of the A. E. F. and it was under his direction that the Signal Corps constructed a long distance telephone system covering France from Marseilles on the south, to Havre on the north,

and from Brest, on the west, to Germany, on the east. After the Armistice he was placed in charge of the American system of communication with the Peace Congress where he rendered invaluable assistance to the American Commissioners.

While in France, General Carty received the Distinguished Service Medal from the hands of General Pershing.

He was also honored by the French Government, being made an officer of the Legion of Honor. The Emperor of Japan has also decorated him with the Imperial Order of the Rising Sun and the Order of Sacred Treasure. Twice the Imperial Government of Japan has tendered him its formal thanks for his service in connection with the establishment and development of the telephone system in Japan.

General Carty has received the degree of Doctor of Engineering from Stevens Institute of Technology and from New York University; the degree of Doctor of Science from Yale, Princeton, the University of Chicago, Bowdoin and Tufts, and the degree of Doctor of Laws from McGill University and the University of Pennsylvania.

The Franklin Institute of Philadelphia has awarded him the Edward Longstreth Medal of Merit for his engineering work and also the Franklin Medal which is the highest honor bestowed by the institution. The American Institute of Electrical Engineers awarded him the Edison Medal for "work in the science and art of telephone engineering."

General Carty is one of the leaders in the movement to encourage scientific research in the universities of this country

and also among various industries. He is a trustee of the Carnegie Institution at Washington and of the Carnegie Corporation of New York, member of the National Academy of Sciences, the National Research Council, Fellow of the American Academy of Arts and Sciences, Fellow in the New York Academy of Sciences, Fellow and Past President of the American Institute of Electrical Engineers, former President of the New York Electrical Society, member of the Society for the Promotion of Engineering Education, the American Physical Society, the Franklin Institute, the American Association for the Advancement of Science, the American Philosophical Society and many others.

His clubs include the Century, Lotos, Engineers, University and Railroad Clubs of New York, the St. Botolph Club of Boston, and the Engineers Club of Dayton, Ohio.

General Carty continued his connection as Chief Engineer of the American Telephone and Telegraph Company until June of 1919, when he was elected Vice-President of the American Telephone and Telegraph Company and placed at the head of the Department of Development and Research. During 1925 the Bell Telephone Laboratories was incorporated and General Carty became Chairman of its Board of Directors.

Among the numerous inventions and scientific contributions of Mr. Carty, are the following:

Patent No. 449,106, Mar. 31, 1891 - Telephone circuit and apparatus. Prior to the work done by Mr. Carty and represented in this patent, the employment of a number of way-stations

(party line stations) destroyed the balance of the metallic telephone circuits, thus rendering transmission noisy. It also directly prevented successful transmission of speech quite independently of the existence of noise.

Throughout the United States, such lines were a continued source of annoyance and difficulty and seriously retarded progress of the telephone, not only in cities but particularly in rural districts. All of these difficulties were removed in consequence of this work done by Mr. Carty. By means of the bridging bell which he designed, any desired number of stations, say up to twenty, might be connected to a metallic circuit line without in the slightest degree interfering with the transmission. All farmers' lines everywhere in this country and in other countries employed the bridging bell method designed by him.

Patent No. 442,856, Dec. 16, 1890 - Means for reducing inductive disturbances in telephone circuits.

In this patent, the use of condensers for overcoming crosstalk is described. This patent is an outgrowth of the new view of telephone induction first proposed by Mr. Carty in his paper before the Electric Club in 1889, and subsequently further developed in his paper on "Inductive Distrubances in Telephone Circuits" before the American Institute of Electrical Engineers, March 17, 1891. These two papers made known the hitherto unappreciated effects of electrostatic action of crosstalk, and required a substantial revision of all previous views concerning the nature of crosstalk and the theory of transpositions. This patent embodies but one of the ideas involved in this new view of telephone induction.

Patent No. 518,319, April 17, 1894, "Telephone transmitter from secondary batteries," is a fundamental patent upon which practically all of the common battery systems are based today. It covers any method of supplying current to two or more telephones from a source having low internal resistance. There is one other method, which is based on the work of Chichester Bell and John Stone, which is not generally employed. These two methods are fundamental, each in its class, Mr. Carty's being the preferred form. Prior to his demonstration every one had failed who had tried to supply current to two or more transmitters from one battery. Mr. Carty was the first to overcome this difficulty.