London
THE TIMES MONDAY MARCH 15 1937

Mr. Hemmings

Obituary

DR. ELIHU THOMSON

ELECTRICAL ENGINEER AND INVENTOR

Dr. Elihu Thomson, the famous American electrical engineer, died at his home at Swampscott, near Lynn, not far from Boston, in Massachusetts, on Saturday at the age of 83. His name was as well known here in his native land as in the country of his adoption, to which he emigrated with his parents at the age of five.

The initials B.T.H., which are so familiar on electrical equipment in offices, in railway trains, tramway cars, private homes, and in many public places, represent the British Thomson-Houston Company, of which he was one of the founders. He has been credited with more than 700 electrical inventions, many of which he produced in the later years of his life, when, as with many of his fellow workers, his mind was still active and clear. Just as it used to be said that there was no ship sailing the seas that did not carry some device which owed its origin to the inventive genius of Lord Kelvin, so in nearly every part of the world many of the articles in most common use were the products of the fertile brain and industry of Thomson. Humanity may look to him as to Kelvin and Edison, whose fame far outstripped his, as one of its greatest benefactors in the last half-century.

Perhaps the most important of all his inventions was the welding of metals by electricity by the resistance method which bears his name and for which he took out his first patent in 1886. It is now extensively employed in all parts of the world. Before that time he had made many pioneer discoveries and inventions in electric lighting. With his partner Houston he inaugurated a system of arc lighting in 1880, and he did much for the production and development of alternating current and in high frequency, a work which formed the basis of the methods subsequently used in the development of wireless. As far back as the seventies he was experimenting with the transmission of wireless waves through brick walls and solid floors, but because of the pressure of other work he did not then pursue his studies in that direction.

One of his earliest inventions for which a patent was issued in 1881 was a machine capable of separating substances of different densities. This was soon turned to practical use in the separation of cream from milk, and the cream-separator is now generally employed in large dairies in all parts of the world.

Elihu Thomson was born in Manchester on March 29, 1853. Five years later he left for the United States with his parents and they settled in Philadelphia, where he attended the Central High School, a technical college. His interest in experimenting and invention was probably due to his father, who was a skilled mechanic. At first his chief interest lay in chemistry, and after having served for a time as an analyst at a factory there he returned to the school to teach chemistry and continued to do so for 10 years, from 1870 to 1880. There he came into close association with Houston, the teacher of natural philosophy or physics at the same school, and the two became fellow workers and partners in all their studies and inventions.

In 1880 they formed a company for the exploitation of their system of arc lighting, and their work became so exacting that they had to resign from their posts at the High School to take charge of it. Two years later their inventions had become so numerous that they had to form a much larger company for their exploitation and it took the names of the founders, Thomson and Houston. Thomson showed a rare genius for organization as well as invention and the new company prospered from its very start. Orders poured in in great numbers and new and larger factories had to be built. In 1892 the Thomson-Houston Company was merged with the Edison General Electric Company to form the General Electric Company, which is known all over the world. Thomson continued his association with the larger organization as inventor and consultant electrical engineer. He took a special interest in the large factory of the company at Lynn, in Massachusetts, and made his home near there, but his work took him to all parts of the United States and to many other countries where the company had its factories.

Even in his old age he continued to be active and prolific in invention. In his seventy-sixth year he undertook the construction of a 200in. periscope, the largest instrument of its kind in the world, which demanded accuracy to the millionth fraction of an inch.

Dr. Thomson was much honoured for his pioneer work in electricity and his services to mankind. In 1924 he came to England to receive the Kelvin medal presented in honour of his distinguished predecessor. It was only the second award and was made on the occasion of the Kelvin centenary. In acknowledging the presentation Thomson spoke of Kelvin as his ideal, as an influence and example that was not to be estimated, lovable as a man and unequalled as a scientific expert, the earliest and greatest electrical engineer.

He was also awarded the Hughes medal of the Royal Society, the Faraday medal given by the Institute of Electrical Engineers in 1927, and the John Fritz medal, the highest American distinction for the advancement of applied science. He had been president of the American Institute of Electrical Engineers, of the International Electrical Congress at St. Louis in 1904, and of the International Electrotechnical Commission which met at Turin in 1911. He was an honorary member of the Institute of Electrical Engineers, of the Institute of Civil Engineers, and of the Royal Institution. Just two years ago he was awarded the Grashof medal of the Society of German Engineers. In 1924 he received the degree of doctor of science from the University of Manchester. He was an officer of the Legion of Honour, and many other distinctions of a similar kind came to him during his long life.

In 1884 he married Miss Mary Peck, of New Britain, Connecticut, by whom he had four sons. Mrs. Thomson died in 1916, and seven years later he married Miss Clarissa Hovey, of Boston.

Times 3/15/37

ELIHU THOMSON

In the eighteenth century, when the curious rubbed beeswax and glass and made them attract bits of paper, and the sparks that could be drawn from a Leyden jar were talked about as we talk of the cosmic rays, the word "scientist" was unknown. A man like FRANKLIN was a "natural philosopher." It is a pity that the term has fallen into desuetude. No other designates so aptly the scope of ELIHU THOMSON'S interests, the eclectic character of his many-sided mind. Astronomy, chemistry, mechanics, electricity — he enriched them all. Even as an organizer of great business enterprises he left his mark. In Europe there is still a Thomson-Houston Company that testifies both to the inventive and the business energy of his youth.

THOMSON belonged to the heroic age of BELL, EDISON, WALLACE, GRAMME, BRUSH, SIEMENS, the constellation that made this an electrical age. He was more than scientist, scholar and inventor; for he helped to lay the foundations of a new social order. When he began his work, streets were illuminated by gas, horse cars jogged along, kerosene was still a wonder, skyscrapers were unknown, the telephone was a crude instrument that could barely talk. Long before he died he could look upon cities festooned in electric lights, on electric trains that rushed between cities at seventy miles an hour. He helped to create these things. Some 800 patents speak of a fertility of invention that has rarely been surpassed. In the great central stations are generators that bear the mark of his technical thinking. His lightning arresters protect electrical distribution systems from short-circuits and sudden overloads. The few street arcs that still glow in our cities are partly what he made them. When two pieces of metal are electrically welded together, one of his machines is used. Farmers who whirl cream from milk owe something to his centrifugal machines. For sheer versatility few equaled him in that bright band of inventors that made the last half of the nineteenth century what it was.

Yet it was as the "professor" that ELIHU THOMSON loved to be known. It was no honorary title. He had earned it as a young man by teaching chemistry and mechanics in Philadelphia and later as a lecturer on applied electricity in the Massachusetts Institute of Technology. After all, it is humanity that matters in this world—the humanity that utilizes inventions to lift itself out of the morass of ignorance and the drudgery of wage-earning. So it was the influence that he exerted as a teacher and the train of thinking that he could start in a receptive mind that meant most to him. If Sir HUMPHRY DAVY could say of FARADAY "that is my greatest discovery," THOMSON could also point to a score of great human discoveries that he had made and developed. If the instinct of invention was strong within him, so was the desire to pass on the torch.

N.Y. Sun 3/13/37

ELIHU THOMSON, INVENTOR, DEAD

Electric Welding Process Discoverer Was 83.

HELD 700 PATENTS IN U. S.

Merged His Firm With Edison's to Form General Electric.

EWAMPSCOTT, Mass., March 13 (A. P.).—Dr. Elihu Thomson, 83, of the General Electric Company, inventor of electric arc welding and contemporary of the late Thomas A. Edison, died today at his home. He had been seriously ill since January.

The famous inventor, who received his first patent on electric welding in 1886, would have been 84 March 29.

At his bedside when he died was his widow, the former Clarissa Hovey of Boston, and his three sons, Roland D. Thomson of Schenectady, Malcolm Thomson of Swampscott and Donald T. Thomson of Rye, N. Y.

Last fall engineers gathered in Detroit and Lynn to celebrate the fiftieth anniversary of Dr. Thomson's discovery of electric welding. At that time he exchanged greetings over a special wire with the two celebrations. It was his last public activity.

Dean of Engineers.

Scientist and inventor, Dr. Elihu Thomson was the dean of electrical engineers and the last of America's "big four" of electricity with Thomas A. Edison, Charles F. Bush and James J. Wood.

When he celebrated his eightieth birthday, President Karl T. Compton of the Massachusetts Institute of Technology said of him:

"More than any man now living, or, in fact more than any man in history, Prof. Thomson has comcombined in a most remarkable way the constructive powers of the inventor, the thoroughness and coundness of the man of science, and the kindly balance of the ideal philosopher, teacher and friend.

Dr. Thomas was born in Manchester, England, March 29, 1853. His parents brought him to this country when he was 5 years old and settled in Philadelphia. From his father, an engineer and skilled mechanic, he inherited his mechanical bent, and he spent the greater part of his time in his father's basement workshop. When he was only 11 years old he constructed a friction electrical machine, using an old wine bottle with a crank at one end.

At 18 he graduated from the Boys Central High School in Philadelphia, and became an instructor in the school, the students being boys of his own age. He later served assistant professor, and in 1876 demon strated his first dynamo before the Franklin Institute. One of his most important early inventions was produced in conjunction with Edwin J. Houston, then professor of natural philosophy at the Central High School. It was a machine for the perfectly continuous centrifugal separation of substances of different densities. The machine was soon in general use in creameries for the separation of cream from milk.

In 1879 he built a dynamo which became the basis for the arc lighting system developed in collaboration with Mr. Houston. At the end of that year Dr. Thomson moved to New Britain, Conn. The Thomson-Houston Electric Company was formed. This concern, with the Edison General Electric Company, later became the General Electric Company. Dr. Thomson held 700 patents in the United States alone.

Dr. Thomson was awarded fifteen medals in this country and abroad for his contributions to science. He was an officer and a chevalier of the French Legion of Honor and held memberships in various engineering societies in the United States and Europe. He was president of the American Institute of Electrical Engineers in 1889-90. He was a member of the corporation of the Massachusetts Institute of Technology for many years and acting president of the school from 1920 to 1922.

Samuel Krulewitch.

Services will be held tomorrow at 12:30 P. M. in the Riverside Memorial Chapel, Amsterdam avenue and Seventy-sixth street, for Samuel Krulewitch, veteran Republican leader, who died of heart disease at 6 P. M. last night in his apartment at 200 West Eighty-sixth street. Interment will be in the family mausoleum in Bayside Cemetery.

In 1906 he was elected to the State Assembly from the old Twenty-sixth Assembly district, now the Seventeenth, remaining there until 1911. Two years after his election he sponsored legislation insuring five-cent telephone calls for New York. From 1908 to 1924 Mr. Krulewitch was a member of the Republican State Committee and for twenty years he was leader of the Seventeenth Assembly district Republican organization. He was also on the Republican county committee and in the fall of 1912 he ran for Secretary of State in New York. He was a delegate to five successive national conventions of his party.

Mr. Krulewitch's other positions included that of Deputy United States Appraiser, to which he was named in 1912, and cashier of the Manhattan branch of the State Excise Department in 1917 and 1918.

Mr. Krulewitch was born in New York on December 24, 1871, and entered politics immediately on leaving school. Although his chief business interests were in real estate durin gthe past five years he has been connected with the Associated Advertising Company in a managerial capacity.

He was a member of the Grand Street Boys Association, a founder of the Amen Club. an organization of the association's members over fifty years old. Also he was a member of Vertis Lodge, F. and A. M., and the Empire City Fraternal Association.

Mr. Krulewitch leaves his wife and three sons, Alvin, Harold and Bertram.

Harry Schreier.

Harry Schreier, real estate official, and public accountant here for forty years, died yesterday at his home, 370 Riverside Drive, in his seventy-ninth year. Among the organizations with which he was connected were Schreier & Hertz, accountants, of 250 West Fifty-seventh street; the Lion Match Company, of which he was secretary and director, and Herbert Hecht Company, of which he was a director.

Mr. Schreier is survived by his wife and four daughters.

Allen W. Nagle.

Allen Ward Nagle, 44 years old, an actor, died yesterday in the Hospital for Ruptured and Crippled. He lived in the Hotel Flanders, 135 West Forty-seventh street. Services will be held on Monday in the New York Funeral Chambers, 172 East Seventy-fourth street.

Mr. Nagle, who was born in Norwalk, Conn., went on the stage in 1923, a few years after attending Fordham. For a number of seasons he was with the Provincetown Players. His Broadway appearances included "Desire Under the Elms" with Walter Huston in 1924, "Gertie" with Nora Bayes in 1927, "The Mystery Man," "Gentlemen of the Press" by Ward Morehouse, Broadway columnist of The Sun, in 1928, and "Fiesta" in 1929. He then took to Shakespearean repertory for some years and during the last year he had been with the WPA Experimental Theater. Surviving are his mother and a brother.

Mrs. J. L. de Peyster

N. Y. Times 3/14/37

ELIHU THOMSON, 83, SCIENTIST, IS DEAD

Invented Some Basic Features of Electrical Development —Held 800 Patents

WON HIGH HONORS IN FIELD

Founded One of Companies of Which General Electric Was Originally Formed

SWAMPSCOTT, Mass., March 13 (AP).—Dr. Elihu Thomson, scientist and pioneer in electrical development, died at his home today at the age of 83.

The inventor, originator of electric arc welding, had been ill since January. A contemporary and friend of Thomas A. Edison, he had only a few years ago cooperated in building the huge seventeen-foot quartz reflector for the world's greatest telescope.

Was a Leading Modern Scientist.

The name of Elihu Thomson has been one of the foremost among great men of science of this age. He was one of the pioneers in the field of electrical science, and if he was not associated in the public mind with inventions as dramatic as those of Thomas A. Edison it was because he was always more the scientist than the contriver.

His technical work was directly reflected in practical developments. He was one of the most far-sighted of the early arc-light inventors, and he experimented with the principle of alternating current transmission far in advance of commercial demands. No less than 800 patents were held by Professor Thomson, and he was honored by scientific societies and institutions the world over.

A group of distinguished scientists paid tribute to Dr. Thomson on his eightieth birthday in 1933. They heard Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, characterize him in these words:

"More than any man now living, or, in fact, more than any man in history, Professor Thomson has combined in a most remarkable way the constructive powers of the inventor, the thoroughness and soundness of the man of science and the kindly balance of the ideal philosopher, teacher and friend."

Professor Thomson originated the resistance method of electric welding, which has been in continuous use from 1887 to the present time. He developed the repulsion type of induction electric motor. He invented the magnetic blow-out principle in lightning arresters and electric switches, the oil-cooled type of transformer, the constant-current transformer and the modern process of commercially treating fused quartz.

In 1883 Professor Thomson was the principal organizer of the Thomson-Houston Electric Company, which was merged with the Edison General Electric Company to form the General Electric Company of today. Mr. Thomson had been associated with the General Electric Company, and at his death he was the dean of the company's staff of scientists. For more than fifteen years he was director of the Thomson Research Laboratory, located at the River Works of the General Electric Company at Lynn, Mass.

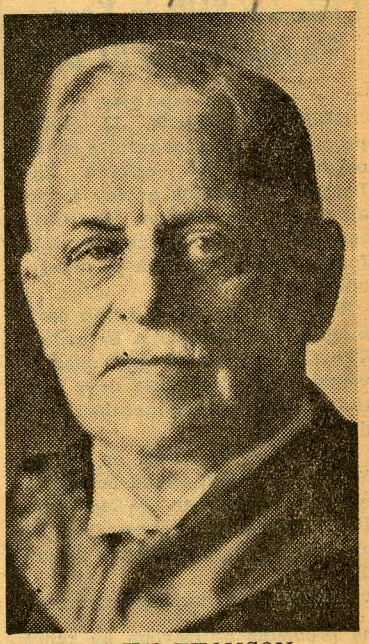
Delved in All Electric Fields.

In the field of electrical science there was scarcely any aspect in which Professor Thomson had not been active at some time or other. More than ten years before Hertz in Germany discovered the electromagnetic waves of radio, Professor Thomson was demonstrating—in 1875 at Philadelphia—the transmission of signals without wires. He discovered the three-phase electric dynamo machine in 1879 and, during the same year, he anticipated experimentally the modern practice in transformer work. He invented the first practical watt meter, thereby winning half of the grand prize offered at the close of the Electrical Exposition held in Paris in 1889.

Professor Thomson was active outside of electrical matters. He invented the centrifugal cream separator and the centrifuge, an instrument now used universally in biological laboratories. He also devised the fluid pressure engine and the fused quartz mirror for astronomical telescopes.

Since he was a boy he had made a hobby of astronomy. He was also interested in microscopes, autochrome photography and in the building and playing of pipe organs.

Elihu Thomson was born in Manchester, England, the son of Daniel



ELIHU THOMSON

England, to observe Donati's comet of 1858, and the memory of that spectacle never left him. As a youth he indulged his mechanical aptitude in the grinding of lenses for both telescopes and microscopes. At his home he constructed telescopes with well-corrected lenses up to ten inches in diameter. All through his life he had his private observatory and telescope.

While professor in the Central High School, Mr. Thomson discovered the principle of electric resistance welding which he developed for commercial use several years later. The American Electric Company, at New Britain, Conn., was organized expressly to market his own original arc light dynamo and electric lighting system. This was the historic dynamo which first introduced the three-phase winding of the internal circuit, and was capable of producing either direct current or three-phase alternating current, according to whether a commutator or collector rings were used with it.

That was the start of Professor Thomson's career as an electrical inventor and scientist to a manufacturing corporation. It was likewise the beginning of one root of the present General Electric Company.

Won Three Most Coveted Prizes.

Elihu Thomson was the only scientist in the world who had been awarded all three of the great prizes of the English scientific and engineering world. In 1916 he received the Hughes medal from the Royal Society of London. In 1924 he was awarded the Kelvin medal, one of the most cherished of distinctions, and in 1927 he received the Faraday medal from the Institution of Electrical Engineers.

In the United States Professor Thomson was the first man to receive the Edison medal of the American Institute of Electrical Engineers, in 1910. In 1916 he received the John Fritz medal, bestowed only by unanimous recommendation of the four principal American engineering societies. He also received the Elliott Cresson gold medal from the Franklin Institute in 1912. In 1902 he was awarded the Rumford medal from the American Academy of Arts and Sciences. In 1925 he received the John Scott Legacy medal of the Franklin Institute.

For many years he was a member of the corporation of the Massachusetts Institute of Technology and he was acting president of the institute from 1921 to 1924. He was president of the International Electrical Congress held at St. Louis in 1904, and he was one of the six American delegates to the Electrical Congress at Chicago in 1892. He succeeded Lord Kelvin as president of the International Electrotechnical Commission and served from 1908 to 1911.

In 1884 he married Miss Mary L. Peck of New Britain, Conn. She died in 1916. In 1923 he married Miss Clarissa Hovey of Boston. There were four sons by the first marriage, Captain Stuart Thomson, who died in 1919 from disabilities resulting from service during the World War; Roland D., Malcolm and Donald T. Thomson.

Funeral services for Dr. Thomson will be held at 2:30 P. M. tomorrow at the Unitarian Church, Lynn, Mass. The honorary pallbearers will be:

Owen D. Young, Gerard Swope, Dr. Karl T. Compton, E. S. Webster, Dr. Ambrose Swasey, Dr. George E. Hale, J. R. Lovejoy, A. L. Rohrer, G. E. Emmons, Dr. W. R. Whitney, A. G. Davis, Francis R. Hart, Charles B. Davis, Dr. Harvey Cushing, G. A. Cutter, D. C. Jackson, Nelson W. Darling, Frank Cox, I. F. Baker, Herman Lemp, Dr. Arthur E. Kennelly, Dr. Frank Jewett, Dr. Harlow Shapley, Dr. S. B. Wolback, Walter S. Moody, Charles A. Collins, Dr. A. Lawrence Lowell, Charles T. Main, Dr. R. S. Morris, Dr. Harry Goodwin, Dr. W. W. Campbell, Dr. W. D. Coolidge, Dr. Charles G. Abbott, Edward S. Mallinckrodt, Dr. John L. Haney, A. L. Ellis, Martin P. Rice, Henry Butler Allen and Dr. E. B. Wilson.

and Mary A. Rhodes Thomson. His father, a Scotsman, was a skilled engineer and mechanic. When the lad was 5 years old the family came to the United States and settled in Philadelphia, where the boy received his early schooling. While yet two years below the age limit at which pupils were admitted to the Central High School, he was prepared for the high school course. During the period of enforced idleness his inherited mechanical instincts led him to build models of pumps, and later into experiments with electricity.

In high school he continued his researches into electricity and chemistry and was soon called upon to assist in the chemical department of the school. From then his promotion was rapid, until, in 1876, when only 23 years old, he was appointed to teach chemistry and physics at the Central High School.

Met Co-workers of Later Life.

It was at this school that Professor Thomson met his co-workers, Professor E. W. Houston and E. W. Rice Jr., whose names were associated with his own in many electrical inventions. In 1880 he resigned the professorship to take the position of electrician with the American Electric Company, which later became the Thomson-Houston Company.

In 1876 and 1877 Professor Thomson, in illustrating lectures before the Franklin Institute, Philadelphia, made use of his first practical dynamo.

When a child of 5 he was taken out one night, while still living in

TRIBUTES BY COLLEAGUES

Inventor's Work Is Praised by General Electric Leaders

Colleagues of Elihu Thomson in the General Electric Company yesterday paid the following tribute to the scientist:

GERARD SWOPE, President of General Electric—You know how deep is my feeling and the feelings of the 60,000 General Electric employes in the loss of dear Professor Thomson. His contributions were of the greatest value to the General Electric Company and the electrical industry. His life was an inspiration to his associates and will long remain a tradition to the General Electric Company.

Dr. W. D. COOLIDGE, Director of General Electric Research Laboratory—Great in engineering and invention, he played a most important rôle in the early development of the electrical art. He was a true scientist, and by example and precept established the tradition of scientific research in the General Electric Company.

Dr. WILLIS R. WHITNEY, Vice President of General Electric—We New England chemists knew him as an expert in our field, just as the electrical engineers recognized him as pre-eminent in their field and the mechanical engineers as a leader in theirs. Astronomers also knew that he was one of their group. He was an all-around scientist.

THOMSON DIES; PIONEER OF G. E.

Last of "Big Four" of U. S. Electrical Industry One of Concern's Founders.

Special to the World-Telegram.

SWAMPSCOTT, Mass., March 13.—Dr. Elihu Thomson, one of the founders of the General Electric Co. and director of the company's research laboratory at Lynn, Mass., died today at his home here.

He was 83 years old, the last of America's "big four" of electricity. With Thomas A. Edison, Charles F. Brush and James J. Wood he was one of the group of inventors that developed the present electrical industry.

During his life time Dr. Thomson obtained more than 700 patents, starting in 1886 with an electric arc welding process which made him famous and wealthy.

Perfected Radio Device.

He invented the electric locomotive, the watt-hour meter to measure electricity; the alternating current repulsion motor; a device to produce the electrical waves now used in radio and the centrifugal cream separator.

After his discovery of electric welding, Dr. Thomson's name was given to the Thomson-Houston Electric Co., organized in 1883. In 1892 the company was merged with the Edison General Electric Co. to form the General Electric Co. of today.

Born in England, Dr. Thomson emigrated with his parents to America at the age of 5. In early manhood he was a teacher in Central High School, Philadelphia.

Inventor at Eleven.

He was 11 when he executed his first "invention," using a wine bottle to make a machine that would produce an electric spark.

Dr. Thomson had long been afflicted with asthmatic and bronchial disturbances which limited his activity. He made his last public appearance six months ago when engineers gathered in Detroit and Lynn to celebrate the fiftieth anniversary of his discovery of electric welding.

At his bedside when he died were his wife, the former Clarissa Hovey, of Boston, and his three sons by a previous marriage, Royand D. Thomson, of Schenectady; Malcolm Thomson, of Swampscott, and Donald T. Thomson, of Rye, N. Y.

Compliments of D. C. J.

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ELIHU THOMSON *

(1853–1937)

It is with regret and sorrow that I speak of the death of Elihu Thomson. I am sure that all members of the American Philosophical Society join in the regret and sorrow for

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the loss of this great man. Science has lost a great creative mind; electrical engineering has lost a giant in invention; the nation has lost a great citizen; and we have lost a friend and loved colleague.

He was elected a member of this Society sixty-one years ago (April 21, 1876) when he was twenty-three years of age, and continued in enthusiastic membership until his death near the end of the eighty-fourth year of his life. He served as a Councillor of the Society from 1917 to 1919, and as a Vice-president from 1928 to 1934. At the date of his death on March 13, 1937, he was by several years the senior in term of membership among all the members of the Society. He had been active in the interests of the Society during six decades. Association with the members of this Society and attendance on its meetings seemed to charm and satisfy an appetite of his broadly intellectual character. When, during the latter years of his life, he and Mrs. Thomson made a practice of going south to avoid the rigors of the New England climate in February and March, he made it a matter of primary satisfaction and pleasure to determine their return journey so as to bring them to Philadelphia at the time of the annual meeting of this Society.

Thomson was a cherished member of many other distinguished scientific and professional academies and societies at home and abroad. He was a charter member of the American Institute of Electrical Engineers, its fifth president and its first recipient of the greatly respected Edison Medal. Of medals, honorary memberships in dignified societies at home and abroad, honorary academic degrees and other distinctions, his number was legion. His central interest was in the development of electrical engineering industries but his many-sided mind touched many collateral fields.

He was one of that group of giants (of which exemplars are Edison, Thomson, Bell, Weston, Sprague and their like in our country and the great Werner Siemens and his compeers in Europe) who ornamented the generation bridging

a gap in time and electrical engineering achievement between the generation of one hundred years ago containing such men as Faraday and Ampère and the generation of younger men who have fruitfully carried forward in the field. Thomson was one of the most creative and one of the last of those giants in applied electricity who adorned the bridging generation and brought us to our modern achievements in the serviceable and comforting uses of electrical apparatus and electricity.

Let me emphasize that in here speaking of these achieve ments, I refer to them as having proved to be serviceable and comforting. Later I refer to them as having contributed to the comfort and thus the happiness of men. Persons of distinguished name sometimes unreservedly state that the broad results of scientific discovery and invention have been causes of increased human disparity or even of war. This I deny. Such allegations are the outcome of incomplete observation. Our powerful and convenient processes of transporting men, animals and goods, associated with extended means for quickly transmitting intelligence, have been impressed into service by sovereign agencies for the purpose of widening the fierce conflicts of war and deepening the opportunities for bloodshed, thereby momentarily converting these processes from blessings into a curse. Similar misuse has been made of other products of inventive genius; and such products are not always used to the greatest humane advantage in peace. But no men have more deeply deplored this incomplete use or even grave misuse of their discoveries and engineering inventions than such men as Thomson.

The practice of engineering, and the prosecution of scientific discovery and invention within the field of engineering, lead to an intellectual richness which encourages a pacific attitude associated with complete patriotism and love of country. Such was the case with Professor Thomson. Unhappily such men are a minority in the world's population. The touch of jealousy, love of revenge and

joy of combat are so ingrained in most human natures that the reluctance of scientific-minded inventors to allow their works to be applied in warfare or in other misuse has had little influence in restraining such applications. Here is one of those problems for statesmanship that are universally human and spread far beyond the fields occupied by those men who are devoted to scientific discovery, invention and professional engineering practice. We therefore cannot put on our Faradays, Edisons, Thomsons and the like the onus for the misuse of their works. Such men stand in support of the greatest beneficial use of their discoveries and inventions.

Thomson's activities were widely extended, reaching from observations in various fields which he cultivated for intellectual interest and recreation (such as descriptive astronomy) to experimental discoveries leading into inventions relating to applied electricity that cover the range from devices of minor character to the bases of a new and valuable industry. The United States Patent Office has borne witness to his productivity in invention by issuing to him patents for inventions which are said to exceed seven hundred in number. I will not enumerate the list, significant as it might be made. To this Society it is particularly of interest to dwell upon his intimate relations with Philadelphia, his employment at the youthful age of seventeen on the staff of his alma mater (the Central High School), his early interest in experimental science and invention while yet a teacher, his active part in the laboratory and lectures of the famous Franklin Institute, and his lively participations in the functions of this distinguished Society. It was in this Philadelphia period that he made, or laid the foundations for, a number of his most important inventions. To his last days, he held a strong affection for the Franklin Institute—for, in its laboratories in the old quarters, he obtained the opportunities to carry on much experimental work in addition to that which he carried on at the Central High School.

I first met Elihu Thomson in 1886, when he was thirty-three years of age and I was twenty-one. Twelve years make the difference between youth and maturity at those ages and I was fascinated by Thomson's constructive activity of mind and his mature processes of analysis which were exhibited in conversation. He delivered a lecture at Cornell University and, as one of the very few graduate students who chose electrical engineering in those days, it was my fortune to be thrown in considerable personal contact with him while he was there. His descriptions of his methods of work, which showed his foresight in planning experiments and his fertility in filling up by empiricism the gaps in rigorous science applicable to problems of engineering design, were significant and inspiring in high degree. This was a half-dozen years after he had relinquished his posts in Philadelphia to go to New England to take up the heavy burdens of chief technical guide in a commercial development of the uses of the electric current. It was also some years before his achievements had assumed that notable international aspect which led to a great flow toward him of distinguished medals and official honors. In later years I have been impressed again and again by the unconscious manifestation by him of those same rich qualities of mind in his scientific work, his business affairs, his social relations, and in his happy family relations. In those qualities, so unusually developed, lay not only the foundation for his personal achievements, but also a good deal of the basis for that attraction with which he drew others to him.

When Thomson was eighty years of age, in 1933, he had been officially associated with Massachusetts Institute of Technology (as a member of the corporation) for forty-five years, during which period he had been called upon frequently for committee duties including membership in the executive committee of the corporation and in the Visiting Committee of the Electrical Engineering Department. Of the latter department I had been in charge for twenty-

six years at that date and (from time to time) had seen much of Thomson. His interest in the institute and active solicitude for the welfare of its work had led to his choice as acting president during an interregnum in 1920–23. When a formal celebration of his eightieth birthday was proposed, the institute gladly undertook to sponsor it, the chairmanship of the planning committee falling to me. The celebration took the form of a scientific conference in the afternoon and a formal dinner in the evening of March 29, 1933, which was his birthday. The affair is recorded in a printed booklet of eighty pages.

I speak of this birthday celebration because the interest expressed in it by societies and individuals throughout the world was very great and was crowded with spontaneous tributes of affection and respect for Thomson and his works. Such expressions flowed in in great numbers by mail and by wire, in formal and in informal garb. A gracious tribute (among very many) came from this distinguished society, another from alumni of the Central High School and another from the Franklin Institute. I will quote a paragraph from that of the Franklin Institute. After reciting certain of Thomson's activities in the Franklin Institute the tribute uses these beautiful words:

> "The Franklin Institute is proud of Dr. Thomson's affiiliation with it; it is grateful for the scientific spirit which he instilled into it; it has been eager to pay honor to him because of his contributions to the advancement of mankind; and it is today filled with affection for him because of his agreeable personality and his rugged nobility of character."

Elihu Thomson was a man who worked to better the conveniences available to his fellow men, for the very joy of it. His works are known from East to West and from the zone of the Pole Star to that of the Southern Cross. His achievements have contributed so much to the comfort and happiness of men that the world owes him an inextinguishable debt. In his death, our Society's loss is great.

Death has erased from our list a great and creative soul of uniquely brilliant parts.

DUGALD C. JACKSON.

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Vol. 72, No. 10, 1938.

ELIHU THOMSON (1853–1937)

Fellow in Class I, Section 2, 1888

Elihu Thomson was born in Manchester, England, on March 29, 1853, and came to this country as a child when his father's employment brought the family to America to locate in Philadelphia. He was the second in a family of eleven children. He evinced great interest in science from early years. When he was eleven years old, his mother provided him with a book called "The Boy's Own Book" that described scientific phenomena together with illustrations of simple apparatus and experiments. The contents of that book so greatly stirred his imagination that he would refer to the effect even in his later years.

Entering the Central High School in Philadelphia at the earliest admissible age (thirteen years), chemistry and physics proved to be his favorite studies. He graduated in 1870 and was promptly made a member of the school staff, to teach chemistry. From that point started a career of scientific investigation, discovery, and invention that continued unremittingly until the advent of his final illness. In these teaching days he was greatly indebted also to the Franklin Institute, the laboratory and lecture room facilities of which afforded him many opportunities for satisfying his tastes. His death occurred on March 13, 1937, fifty-seven years after he left his post at the Central High School to enlarge his opportunities for discovery and invention and to take a leadership in manufacturing his own inventions.

Competent authority has entitled him a Modern Faraday. There was much of kin in the intellectual qualities of the two men, but their tastes led them along different creative paths. Michael Faraday was possessed with avidity to discover and explain the interrelations of phenomena of nature. Leaving to others the further investigations needed to apply his discoveries in devices of material utility for man, he extended his own researches among phenomena so that his discoveries are fundamental to a wide world of chemistry and physics,

and his name is a word to conjure with in circles where science is cultivated. Elihu Thomson was interested in discovering relations of phenomena, but his avidity (contrary to that of Faraday) was for securing devices of utility for man from applications of his discoveries and also from already known factors in the field of science. Being one who foresaw that (in material comforts) "Change may never change or pass away," to use Swinburne's phrase, Thomson pursued a fertile career primarily in invention, until his name became of world-wide fame in circles of engineering and notably of electrical engineering. His temperament is illustrated by his own words expressed at a commemorative dinner held in 1930, "No greater joy has come to me than the joy of accomplishment. Then, too, I have had the satisfaction of aiding in giving employment to large numbers of intelligent men and women."

Each of these two scientists contributed magnificently to human welfare and happiness, directly or indirectly. Each deserves and has received world acclaim for his achievements. The differences between their tastes and therefore between the scopes of their endeavors makes a more exact comparison impracticable as well as unnecessary.

Elihu Thomson was one of the now rapidly disappearing generation of men who, by discoveries and inventions, wrought electrical engineering out of the early scientific foundations into the aspect of a great contribution to human comfort and happiness; and he was one of the greatest of that remarkable group. His achievements have directly contributed so much to the comfort and thus to the happiness of men that the world owes him an inextinguishable debt.

Thomson was elected a Fellow of this Academy on March 14, 1888, upon nomination of Charles R. Cross, John Trowbridge, and Silas W. Holman, honored professors of physics in Harvard and M.I.T., all now in their graves. Accordant with his custom concerning scientific societies that attracted his interest and affection, he took lively part in Academy affairs, habitually attended the meetings, presented communications in 1900, 1910, 1912, 1919, 1922, 1933, and in 1928 wrote the Memoir of Professor Charles R. Cross, one of his nominators. He was a Member of Council, 1904–1908, Vice President 1908–1923, and Member of the Rumford Committee from 1903 until his death. He was awarded the Rumford Medal in 1901 "for his inventions in electric welding and lighting."

The wide recognition of his work (especially during his later years) is indicated by his scientific society memberships and important medals conferred on him at home and abroad. It is said that no other man has been recipient of all three of the great British medals granted by great engineering and scientific associations. Few have ever received such a distinguished series of medals.

Honorary academic degrees of Ph.D. in 1894, Sc.D. in 1909 and LL.D. in 1924 have been conferred on him respectively by Tufts College, Harvard University and University of Pennsylvania. Victoria University, Manchester, England (his birthplace), conferred on him its degree of Sc.D. in 1924.

The importance of Thomson's work and the extent of its appreciation are well illustrated by the fullness of these various forms of recognition. The magnitude of his work of invention is indicated by the statement that over seven hundred patents have been issued covering inventions which he made. It is not appropriate here to make an enumeration, but those inventions have affected electrical engineering prodigiously. The earliest one of importance (made while he was still in Philadelphia) was the automatically regulating arc-light dynamo with three-coil spherical armature and blow-out arc-extinguisher at the commutator. This had great influence on the development of arc-lighting in the early days of electric lighting service. In the same early days he demonstrated in one experiment the reversibility of induction coils and the process of butt-welding by electric current. His manner of working and the meagreness of knowledge regarding electric circuits in those days are illustrated by a statement of Thomson reported by Dr. C. F. Scott. "The Rhumkorff Coil" (said Thomson) "uses a low-voltage current for producing a very high voltage. I wondered if the process could be reversed and the high-voltage current in the fine winding would produce a current in the heavy winding. I was fearful of the results [i.e. to the coil] and put off experiments until I had a coil of my own. I placed the ends of the heavy terminals close together and observed carefully when the Leyden jars were discharged through the fine wire coil. There was a flash and when I attempted to separate the terminals I found them solidly welded together. That was the beginning of my work in electric welding." These observations contributed later to Professor Thomson establishing the extremely serviceable art of resistance

electric-welding and to his making important inventions in the field of electric transmission of power. Other observations in these Philadelphia days led to additional later important inventions.

When incandescent electric lighting was growing up, the art was at a disadvantage from lack of a simple registering meter comparable in qualities to a gas meter. Thomson's meter filled that gap and won for him the Paris Meter Prize in 1890 besides going into wide use. He produced lightning arresters for electric circuits with magnetic means for causing extinguishment of the sustained arc when the arrester operated in an electric power circuit. That "magnetic blowout" device has become so entwined in electrical engineering that its applications in electric circuits are innumerable. In his electric light and power developments he always gave great concern to the question of safety of the public and of users of the current. He was a leader in this direction of thought.

He early worked in the field of high-frequency currents and in the field of X-rays, with some discoveries and inventions in each, including the production of stereoscopic X-ray pictures. He discovered the repulsion forces caused by the magnetic effects of alternating currents acting on adjoining closed conducting circuits and utilized the phenomena in invented devices. And thus he went through the gamut of electrical affairs that attracted his attention and interest; nor did he wholly neglect the fields of chemistry and mechanical engineering.

He was happily married twice, once in 1884 with the issue of four children, and again in 1923. He had deep interest in children. His long-time and loyal secretary has said that he has frequently seen him "lose himself entirely in preoccupation with children's activities and it was always with great difficulty that we could revive his attention to some important matter, and then only with one eye cast eagerly in the direction of the children." He also was careful of the welfare of the young men who became his assistants, and many men who now are of importance in electrical engineering ascribe much of their success to their early relations with Professor Thomson. The adequacy and smooth sequences of his intellectual processes were always inspiring to young men.

He was devotedly interested in education to the end of his days and his relations with M.I.T. and Harvard University were among his happiest. He became formally a lecturer in electrical engineering at

M.I.T. in 1894 and so continued to the day of his death. He was elected a life member of its Corporation in 1898, was Acting President in 1920–1923 during an interregnum, and of late years was a member of the Executive Committee of the Corporation. From time to time he was member of Visiting Committees of departments such as electrical engineering, physics and other sciences. His devoted service to M.I.T. and also to Harvard as a visitor and adviser, make education in science and engineering his debtor.

In addition to his absorbing professional occupation Professor Thomson took much interest in each new scientific phenomenon that came to his attention. A number of his brief articles published in Science or elsewhere related to such matters. He was a happy follower of several scientific avocations, principally as an amateur in astronomy, in music, and in color photography. For the former he built a small observatory on his place in Swampscott, Mass., in which was a modest telescope which he built for himself, even to the grinding of the lenses. He built for himself a pipe organ on which it was his pleasure to perform. And in his later years his wife was his congenial and perfect companion in the joys of color photography.

His personal characteristics were so admirably summed up at the Eightieth Birthday Dinner by Edwin W. Rice, Jr. (at first a student and then a life-long colleague of Thomson, than whom no man knew Thomson so well), that I quote his words: "Throughout his whole career Professor Thomson has exhibited an unerring capacity for the selection of that thing or that process which was soundest and best, and simplicity and directness always characterized his designs. . . He seems to possess an intuitive insight into nature and her ways; probably because of the quickness and accuracy of his perception, combined with the depth and range of scientific knowledge, helped by a remarkably retentive memory. Difficulties never discourage him, but only stimulate him to greater endeavor. . . . He has been a prolific inventor, a trained engineer and an inspiring teacher. Our generation has produced men who may have equalled or excelled him in some one of these fields, but no one has arisen in the generation who to such a superlative degree combined the quality of inventor, engineer and teacher."

DUGALD C. JACKSON

P. C. Sowersby, News Bureau
General Electric Company
Schenectady, New York

Portrait on request

DEATH OF PROFESSOR ELIHU THOMSON

Professor Elihu Thomson, 83, dean of American scientists, and one of the founders of the General Electric Company, died at his home in Swampscott, Mass., March 13. He had been seriously ill since January. Professor Thomson, together with Thomas A. Edison, James J. Wood, and Charles F. Brush were the great quartet which created the modern electrical industry. Funeral services were conducted in Lynn, Mass.

Honorary pallbearers included Owen D. Young, Gerard Swope, Dr. Karl T. Compton, E. S. Webster, Dr. Ambrose Swasey, Dr. George E. Hall, J. R. Lovejoy, A. L. Rohrer, G. E. Emmons, Dr. W. R. Whitney, A. G. Davis, Francis R. Hart, Charles B. Davis, Dr. Harvey Cushing, G. A. Cutter, D. C. Jackson, Nelson W. Darling, Frank P. Cox, I. F. Baker, Herman Lemp.

Dr. Arthur E. Kennelly, Dr. Frank Jewett, Dr. Harlow Shapley, Dr. S. B. Wolback, Walter S. Moody, Charles A. Collins, Dr. A. Lawrence Lowell, Charles T. Main, Dr. R. S. Morris, Dr. Harry Goodwin, Dr. W. W. Campbell, Dr. W. D. Coolidge, Dr. Charles G. Abbott, Edward S. Mallinckrodt, Dr. John L. Haney, A. L. Ellis, Martin P. Rice, Dr. E. D. Wilson, Henry Allen, Dr. Frank R. Lillie, Laurence Jenkins, and Stephen W. Phillips.

Elihu Thomson was one of America's greatest pioneers in the field of electrical science. His technical work was direct-

ly reflected in practical developments, as he was one of the most far-sighted of the early arc-light inventors, and experimented with the principle of alternating-current transmission far in advance of commercial demands. He held upward of 700 patents in the United States alone.

He originated the resistance method of electric welding, which has been in continuous use from 1887 to the present time; developed the repulsion type of induction electric motor; invented the magnetic blow-out principle in lightning arresters and electric switches, the oil-cooled type of transformer, the constant-current transformer, and the modern process of commercially treating fused quartz.

Professor Thomson's name was given to the Thomson-Houston Electric Company, organized in 1883, and merged in 1892 with the Edison General Electric Company to form the General Electric Company of today. He has ever since been associated with General Electric and at the time of his death was dean of that company's staff of scientists. For more than 15 years he was director of the Thomson Research Laboratory, located at the River Works of the Company at West Lynn, Mass.

There was scarcely any aspect of electrical science in which Thomson had not been active at some time or another. More than 10 years before Hertz in Germany discovered the electro-magnetic waves of radio Thomson was demonstrating, in 1875 at Philadelphia, the transmission of signals without wires. He originated the three-phase electric dynamo machine in 1879 and anticipated experimentally, in the same year, the modern

practice in transformer work. He invented the first practical wattmeter, thereby winning half of the grand prize offered at the close of the Paris electrical exposition of 1889.

Outside of electrical matter he was also active. He invented the centrifugal cream separator and the centrifuge, an instrument now universally used in biological laboratories. He also devised the fluid pressure engine and the fused quartz mirror for astronomical telescopes. On this latter development he made many important contributions.

His life-time hobby was astronomy, in which he was active as an amateur at an early age. He was also interested in microscopes, auto-chrome photography, and in building and playing pipe organs. He had a host of friends in scientific and engineering circles, not only in America but in Europe, particularly in England, the land of his birth.

Professor Thomson was the only man who ever received all three of England's highest scientific honors---the Hughes, the Lord Kelvin, and the Faraday medals. He also had the medal of the Verein Deutscher Ingenicure, outstanding German engine eering award, the John Fritz medal from the four leading American engineering societies, and the medals of the Franklin Institute, the American Academy of Arts and Sciences and the American Institute of Electrical Engineers. He was president of the Internation Electrical Congress in 1904, and the president of the Electrochemical Congress in 1910 and 1911. At one time he was vice president of the American Academy of Arts and Sciences and vice president of the American Philosophical Society. He belonged to innumerable engineering societies all over the world.

Elihu Thomson—

March 29, 1853—March 13, 1937

CONCLUDING one of the longest, most varied, and most fruitful careers in electrical engineering, Elihu Thomson died at his home in Swampscott, Mass., on March 13, 1937, just a few days before his eighty-fourth birthday. Indisputably the dean of American electrical engineers, he was regarded as being second to none among the small group of his contemporaries upon whose inventive genius the electrical industry of the world was founded and through whose perseverance and keen foresight it grew.

Recognized for his character and ability, and honored by his contemporaries throughout his lifetime, few men, if any, have contributed more to the progress of the world than did Elihu Thomson, and fewer still have lived to see such full fruition of their ideas. He was one of the last of the original group of great electrical pioneers.

His signature was on the "call" for the May 1884 organization meeting of the AIEE, and Doctor Thomson became a charter member of the Institute. He maintained an active affiliation for the remainder of his life. He is survived by only 3 other charter members whose names still appear on the active list. Although not caring for administrative work, preferring to remain "in the ranks" and closer to his work, Elihu Thomson was elected a vice-president of the Institute in 1887 and immediately upon completion of his term in that office became in 1889 the fifth in the line of great leaders who have guided the Institute's destiny.

Doctor Thomson was particularly active in local Institute affairs, and a perusal of the AIEE PROCEEDINGS prior to 1910 will show that he presented papers and discussions at many Section meetings. He served as a member of the Institute's committees on co-operative research and standardization from 1898 to 1900, and as chairman of the Edison Medal committee from 1911 to 1915. Thomson was not a prolific scientific writer, but the character of his writings is attested by the following papers published in the AIEE TRANSACTIONS:

1. NOVEL PHENOMENA OF ALTERNATING CURRENTS, volume 4, May 1887, page 160.

2. MAGNETISM IN ITS RELATION TO INDUCED ELECTROMOTIVE FORCE AND CURRENT, volume 6, May 1889, page 269.

3. PHENOMENA OF ALTERNATING-CURRENT INDUCTION, volume 7, April 1890, page 132.

4. COMPOUNDING DYNAMOS FOR ARMATURE REACTION, volume 12, June 1896, page 288.

5. A NEW FORM OF INDUCTION COIL, volume 14, July 1897, page 225.

6. CONDITIONS AFFECTING STABILITY IN ELECTRIC LIGHTING CIRCUITS, volume 28, January 1909, page 1.

In 1904 the Institute, in response to an invitation by an organization of associates and friends of Charter Member Thomas A. Edison, undertook the responsibility of making the awards of a gold medal now known as the Edison Medal. Elihu Thomson, in 1909, was the first to receive the award "for meritorious achievement in electrical science engineering, and arts, as exemplified in his contributions thereto. . . ."

In June 1928 the Institute was priviliged to give further recognition to Thomson's services and achievements. The constitution provides that Honorary Members may be chosen, upon the *unanimous* vote of the board of directors, "from among those who have rendered acknowledged eminent service to electrical engineering or its allied sciences." Prior to June 1928 the few distinguished persons thus elected all were from foreign countries, but at that time Thomson's name was included in a list of 5 outstanding American engineers unanimously endorsed by the directors.

THOMSON'S EARLY LIFE

Elihu Thomson was born March 29, 1853, at Manchester, England, to an English mother and a Scotch father. The family came to the United States in 1858, settling in Philadelphia, Pa., where Doctor Thomson attended the public schools. Completing his preparatory education at the age of 11, he had to wait 2 years to meet the minimum age of 13 years required of high school entrants. During this 2-year period, with the encouragement of his parents, he devoted himself to his experiments and his hobbies. He constructed a friction type of electric generator from a wine bottle, and built Leyden jars to be charged by his generator; these and the other similar electrical apparatus of the time were followed by such things as batteries, and electromagnets and telegraph instruments in which the bare wire used for the windings was insulated by the laborious task of winding thread around it by hand. While still a child his interest in astronomy led him to construct his own telescope with the help of a friendly lens maker. In later life he continued the pursuit of this hobby, building powerful telescopes himself and grinding his own lenses.

After he graduated from Central High School early in 1870, he entered a laboratory as an analyst, but was appointed assistant professor of chemistry in the high school later in the same year. In 1876, at the age of 23, he was appointed professor of chemistry in the same school, but he had become deeply interested in the applications of electricity, and in 1880 resigned to devote his entire time to electrical research and development. He always had been fascinated by physical and chemical studies, and especially by electricity.

Possessed of a natural knack for construction and the use of tools, he gave what time he could spare from other duties to making such apparatus as he needed. In this way, before the age of 20, he had built induction coils, electromagnets, cameras, chemical balances, and many other devices. In his early twenties he constructed numerous pieces of scientific apparatus for demonstration and laboratory use, including a compound microscope; also numerous electrical machines and a pipe organ with electrical action for which he made the pipes, windchest, bellows, keyboard, and all other parts.

INDUSTRIAL DEVELOPMENT

When Doctor Thomson resigned his professorship at Central High School in 1880, he took charge of the commercial development of an arc-lighting system for the American Electric Company, a small firm that had been started in Philadelphia in 1879. At the same time E. J. Houston, his colleague at the high school and later a president of the Institute, resigned his teaching position and joined him in the business. Later in the same year the company moved to New Britain, Conn. E. W. Rice, Jr., subsequently a president of the Institute and president of the General Electric Company, accompanied Thomson as an assistant. In 1883 the modest establishment at New Britain was moved to Lynn, Mass., a "Lynn Syndicate," as it was called by Thomson and his associates, having bought control of the American Electric Company. At Lynn the name of the company was changed to the Thomson-Houston Company, and during these pioneer years Doctor Thomson was "electrician" and chief engineer, and many of the fundamentally important inventions upon which the business was established and grew were his. He shunned administrative duties, and the commercial destiny of the company was largely in the hands of Charles A. Coffin.

In 1892, the Thomson-Houston Electric

Company and the Edison General Electric Company were merged to form the General Electric Company. Thomson remained as consulting engineer and director of the Thomson Research Laboratories at Lynn. By his own choice he devoted his time and efforts to research and development rather than to administrative work. Charles A. Coffin became the first president of the new and rapidly expanding company.

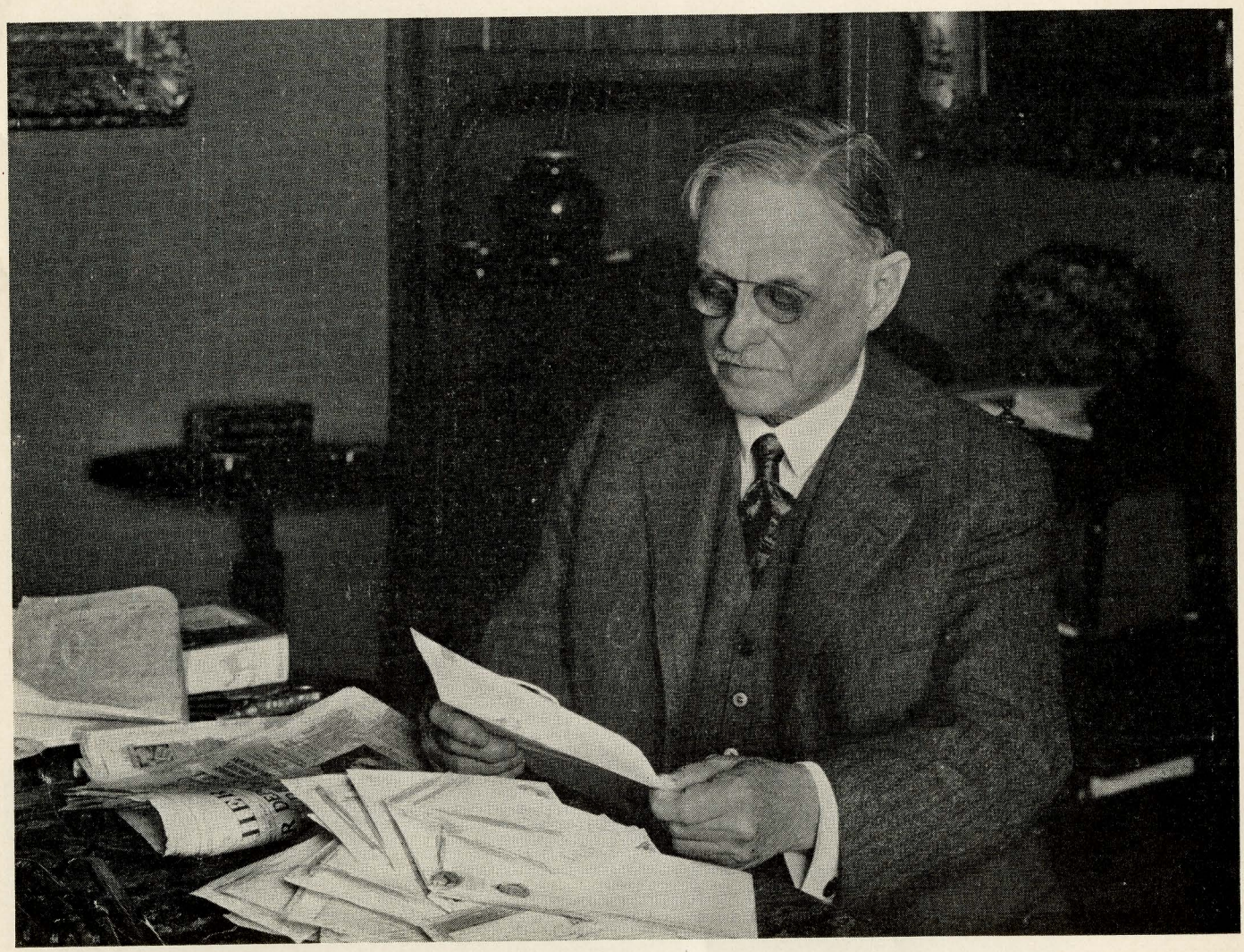
Honors Conferred on Thomson

Elihu Thomson probably was the most honored scientist in America. He was acclaimed by several colleges and universities, receiving the honorary degrees of master of arts (1890) from Yale University, doctor of philosophy (1894) from Tufts College, doctor of science from Harvard University (1909) and the University of Manchester (England) (1924), and doctor of laws from the University of Pennsylvania (1924). He was awarded many prizes, medals, and decorations, and had the distinction of being the only man to receive all 3 of the most important scientific medals of Great Britain: the Hughes Medal of the Royal Society, the Kelvin Medal, and the Faraday Medal of the Institution of Electrical Engineers. The Royal Institution of Great Britain elected Thomson an honorary member, the highest scientific honor that Englishmen can confer upon a foreigner. The complete list of awards, decorations, and medals received by him is impressive:

1. John Scott Legacy Medal, for electric welding, 1888
2. Grand Prix, Paris Exposition, 1889
3. Appointed officer et chevalier of the Legion D'Honneur, 1889
4. Certificate of award of gold medal, Columbian Exposition, 1893; no medal was received
5. First prize, Trans-Mississippi and International Exposition, Omaha, Nebr., 1898
6. Grand Prix, Paris Exposition, 1900
7. Rumford Medal, for electric welding and lighting, 1901
8. John Scott Legacy Medal, for constant-current transformer, 1901
9. Grand Prize, Louisiana Purchase Exposition, St. Louis, Mo., 1904
10. First Edison Medal of the AIEE, 1909
11. Elliott Cresson Medal of the Franklin Institute, 1912
12. John Fritz Medal, 1916
13. Hughes Medal of the Royal Society, London, England, 1916
14. Kelvin Medal, 1924
15. Franklin Medal, of the Franklin Institute, 1924
16. Faraday Medal, Institution of Electrical Engineers, 1927
17. Medal of the Verein Deutscher Ingenieure, 1935

In 1925 Thomson was designated as "father of protective grounding" by a resolution adopted by the Western Association of Electrical Inspectors. He was one of 6 official United States delegates to the chamber of delegates of the electrical congress in Chicago in 1893; president of the International Electrical Congress in St. Louis in 1904; a member of the World Engineering Congress at Tokyo, Japan, in 1929; and a United States delegate to the International Electrical Congress at Paris, France, in 1932. Many technical and scientific organizations including the Institute, had conferred honorary membership upon Doctor Thomson. These were:

1. Franklin Institute
2. Institution of Civil Engineers (Great Britain)
3. Institution of Electrical Engineers (Great Britain)
4. Royal Institution (Great Britain)



A photograph showing Doctor Thomson on his eightieth birthday, reading some of the many congratulatory letters that came to him from all parts of the world on that occasion

In Memoriam

ELIHU THOMSON

DR. ELIHU THOMSON, a charter member, the fifth president, and an honorary member of the American Institute of Electrical Engineers, died at his home in Swampscott, Mass., on March 13, 1937, about two weeks before his eighty-fourth birthday.

Beginning his electrical experiments at the age of eleven, when he had completed his preparation for high school but found it necessary to wait two years to meet the minimum age requirement for entrance, he built and operated several types of equipment, and quickly demonstrated his ability in fundamental science and also his remarkable inventive genius. After graduating from the Central High School in Philadelphia and teaching chemistry and mechanics in that school during the next ten years, he resigned in 1880 to devote his entire time to electrical research.

The American Electric Company which he joined soon became the Thomson-Houston Company and the latter merged, in 1892, with the Edison General Electric Company to form the General Electric Company, with which Dr. Thomson was connected until his death.

His more than 700 inventions included many of outstanding importance which added materially to scientific knowledge and laid the foundation for many significant developments in the electrical industry. The combination of marked scientific ability, broad vision, sound judgment and pleasing personality gave him a position of outstanding leadership throughout his long career.

He received the first Edison Medal awarded by the Institute, and received many of the most notable medals in the world, having been the only man to receive all three of England's highest scientific honors, the Hughes, Kelvin, and Faraday medals. He received several high honorary degrees, including Ph.D. ScD., and LLD. He was elected an Honorary Member by the AIEE and several other societies, and received other high honors in the United States and abroad.

Entering the Institute as a charter member, he immediately became active in its affairs, and was a vice-president 1887–89, and president 1889–90. He also rendered valuable services to the Institute as member of various important committees and as its representative in joint activities. He was transferred to the grade of Member in 1891 and to the grade of Fellow in 1913. He was elected an Honorary Member in 1928.

RESOLVED: That the Executive Committee of the American Institute of Electrical Engineers, upon behalf of the Board of Directors and the membership, hereby expresses its keen regret at the death of Doctor Thomson, and its deepest appreciation of his many outstanding contributions to electrical engineering progress, and be it further

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

—AIEE Executive Committee, March 25, 1937.

5. Alumni Association of Massachusetts Institute of Technology
6. American Electrotherapeutic Association
7. American Welding Society
8. American Society of Mechanical Engineers
9. Illuminating Engineering Society
10. New York Electrical Society
11. Engineers' Club, New York, N. Y.
12. Western Association of Electrical Inspectors
13. New England Roentgen Ray Society
14. American Institute of Electrical Engineers

Outstanding Accomplishments

Perhaps the first great contribution to electrical engineering made by Elihu Thomson was his invention, in about 1879, of the 3-coil dynamo with its automatic regulator and other novel features, which formed the basis of the first commercially successful lighting system. This was manufactured by the Thomson-Houston Company in the early 1880's and quickly found its place not only in the United States, but also in several European countries. The machine was entirely automatic in its operation, and was so adjusted that it could maintain constant regulation of a system of many electric arcs, regardless of the number of arcs that might be turned on or off. The need for such a regulator and its general nature were suggested to him by his earliest serious electrical studies, which concerned the relations between the voltage and current in an electric arc, and which led him to the discovery that as the current increases the voltage decreases. This relation accounted for the instability of the arc and indicated what characteristics the dynamo should have. This 3-coil dynamo was a d-c machine, for at that time direct current was more easily handled than was alternating current, and had certain advantages for arc-lighting purposes. The same machine, however, with different connections, constitutes the 3-phase generator that is so important in present electric power installations, and was so represented by Thomson in his original patent application.

While he was working on his arc-lighting system, Thomson heard that Edison was tinkering with an incandescent lamp. Accordingly he went to Menlo Park to discuss the matter with Edison, who gave him a model of the lamp. This model subsequently was dissected by Thomson and Houston, with the decision that it never would amount to anything.

Lightning Protection—Magnetic Blowout

About 2 years later, in 1881, he invented another important electrical device: the magnetically operated lightning arrester. Although this arrester was created for the particular purpose of protecting his arc-light systems from lightning, it was the invention of a fundamental method of breaking electrical circuits that has found numerous applications, one of the most important of which was by Doctor Thomson himself in control contactors for electric cars and trains. The device consisted of an insulator so placed between the poles of a magnet, and the whole so arranged with respect to the contacts or electrodes, that any arc forming was forced by the magnetic field to elongate itself to the breaking point, thus quickly and effectively interrupting the circuit. This principle is of as much importance today as it was then, for it is the foundation of several modern systems of switching large currents.

Power Transmission

In those very early days of electrical engineering, long before the importance of electric power transmission and distribution was realized generally, Thomson devised the now commonly used method of transmitting electrical energy, stepping it down from high voltage with the aid of a local transformer for local consumption. This was set up as a working model for demonstration at the Franklin Institute in Philadelphia in 1879. A patent was applied for in 1885, and after a strenuous period in the patent office a fundamental patent for multiple-arc distribution systems with transformers was granted in 1902. During this same time Thomson developed and patented the procedure of grounding the secondary of the transformer as an additional safety measure for high-voltage operation. A notable characteristic of Doctor Thomson is indicated by his advice to the General Electric Company that this patent should be dedi-

cated to the public, because no patent or invention dealing with public safety should be restricted or made unavailable for general use.

Developments on the Transformer

In the further development of a-c machinery, he invented the constant-current transformer and the induction regulator, in which a movable secondary or primary coil could be adjusted automatically to give constant-current output. For the purpose of increasing the power capacity of transformers, he proposed in 1887–89 the use of oil for cooling and for insulation purposes, and further called attention to the deleterious effect of moisture in the oil.

Resistance Welding—Repulsion Motor

One of the most important of Thomson's contributions to industry was his discovery of the principles and development of the resistance process of electric welding, whereby the welded surfaces were fused and united by the heat produced by the resistance in the contact between them. Although Elihu Thomson was not the first to utilize the electric arc in welding, the fundamental Demeritens patent was bought by the Thomson Electric Welding Company on Thomson's advice and, had arc welding developed within the life of the patent, that company would have controlled the arc- as well as the resistance-welding art.

Another of Thomson's most fundamental discoveries was the principle of dynamic repulsion between a primary and a secondary coil, which he demonstrated by simple experiments. A vertical iron core was wound with a coil through which an alternating current could be passed. The core projected above the coil into a jar of water. Fitting loosely around the core was a second small coil, free to slip up and down the core in the water, and supporting by its terminals an incandescent lamp. When an alternating current was sent through the primary coil, a current was induced in the movable secondary coil, which lighted the lamp and at the same time raised the coil against the force of gravity high up in the jar of water. This scientific observation subsequently was developed by Thomson into an a-c repulsion motor.

Meters—High-Frequency Apparatus

During the years 1885–95 Doctor Thomson was busily engaged in the development of electric meters, especially recording wattmeters. For his wattmeter he was awarded the Grand Prix of the Paris Exposition at a competition held after the exposition in 1889.

As early as 1890, and continuing intensively for several years thereafter, he conducted a series of experiments on high-

A collection of the medals and decorations conferred upon Elihu Thomson

Top row (left to right): John Scott Legacy Medal, for constant-current transformer, 1901; Franklin Medal, of the Franklin Institute, 1924; Faraday Medal, Institution of Electrical Engineers, 1927; John Fritz Medal, 1916; and John Scott Legacy Medal, for electric welding, 1888

Middle row (left to right): Grand Prix, Paris Exposition, 1900; Elliott Cresson Medal of the Franklin Institute, 1912; Kelvin Medal, 1924; Hughes Medal of the Royal Society, London, England, 1916; and Grand Prix, Paris Exposition, 1889

Bottom row (left to right): First Prize, Trans-Mississippi Exposition, Omaha, Nebr. 1898; Edison Medal, 1909: Legion D'Honneur, officier et chevalier, 1889; Rumford Medal, for electric welding and lighting, 1901; and Grand Prize, Louisiana Purchase Exposition, 1904

A gold medal was awarded to Doctor Thomson at the Columbian Exposition, in 1893, by certificate of award, but no medal was received; he also received in 1935 the medal of the Verein Deutscher Ingenieure, which is not shown here

frequency alternating currents, building the foundation for many of the developments in radio and other high-frequency applications in use today. He constructed one of the first high-frequency dynamos, if not the first; a machine operating at frequencies of from 30 to 40 times as great as any previously built. In conjunction, he designed some of the earliest high-frequency transformers. While Thomson was working in this field he discovered a method of producing alternating currents of still higher frequencies from a d-c arc by shunting the arc with inductance and capacitance. This interesting method of producing alternating currents later was applied to radiotelegraphy by Poulsen, and therefore is generally known as the Poulsen arc. Thomson also discovered that the insulating power of oils at these high frequencies is much greater than at ordinary commercial frequencies, if the insulating power is measured in terms of the path through which the arc passes.

Incidentally, Thomson is credited with having discovered the principle of the tuned electric circuit, and with having been the first to use the method in electrical communication. This was done very early in his career, while he was still a professor at Central High School, in performing some experiments in wireless signaling that preceded the famous experiments of Hertz by about 12 years.

Immediately following the announcement of the discovery of Roentgen rays, Doctor Thomson began a series of experiments and developments in connection with X rays. The foundation for this work had been laid by his previous experiments on electrical discharges through gases at low pressures, and led to the first application of stereoscopic methods in X-ray technology only one year after Roentgen rays themselves had been announced. This work led to various practical improvements in the design of X-ray tubes. Thomson also took an interest in the physiological effects of X rays.

Elihu Thomson also was active outside the domains of electrical research. Working with Houston, while they were at Central High School, he perfected his centrifugal machine for the separation of liquids of different densities, the forerunner of the widely used cream separator and the laboratory and commercial centrifuge. He also devised the fluid-pressure engine and the fused-quartz mirror for astronomical telescopes. In his own name he held more than 700 American patents.

Thomson the Man

In his private life as a citizen, as well as an inventor, Elihu Thomson endeared himself to his neighbors and his fellow workmen and always was considered to be a wise counselor in civic affairs. Even outside his laboratories he was always engaged in some research project as a hobby. A lifetime hobby was astronomy, in which he was active as an amateur from an early age. He also was interested in microscopes, color photography, and in building and playing pipe organs. He had a host of friends, not only in the United States, but also in Europe.

His aspect of life is characterized by his own words "No greater joy has come to me than the joy of accomplishment. Then too, I have had the satisfaction of aiding in giving employment to large numbers of intelligent men and women."

Doctor Thomson was a member of many organizations in addition to those that had awarded him honorary memberships, including:

1. American Academy of Arts and Sciences (fellow and member of the Rumford committee)
2. American Association for the Advancement of Science (fellow)
3. American Astronomical Society (member)
4. American Chemical Society (life member)
5. American Electrochemical Society (member)
6. American Mathematical Society (member)
7. American Optical Society (member)
8. American Philosophical Society (fellow and past-president; also a past member of the council)
9. American Physical Society (fellow and life member)
10. Pi Gamma Mu, national science honorary society (life member)
11. British Association for the Advancement of Science (life member)
12. Engineers' Club of London, England
13. Société Française des Electriciens (member)
14. Commercial and Merchants Club of Boston, Mass. (member and past-president)
15. Engineers' Club of Boston (life member)
16. Boston Press Club (life member)

and 22 other societies and clubs of local, national, and international character.

Doctor Thomson was particularly interested in educational work. His vast store of experience and knowledge always was at the disposal of his younger, less experienced associates, among whom he was noted for his ability to explain the most abstruse subjects in simple, understandable language. He was affectionately known to them as "the Professor," a simple "friendly" title that he strongly preferred in spite of his many degrees. He was a life member of the Corporation of Massachusetts Institute of Technology, a member of the executive committee of the corporation, and twice served as its acting president.

For many of its most fundamental contributions—technical, ethical, and humanistic—the profession of electrical engineering is indebted to Elihu Thomson.

Thomson as Seen By Some Institute Leaders

Arthur E. Kennelly, president 1898–1900—I had the privilege of knowing the late Professor Thomson for many years. He was endowed with great abilities as an engineer, inventor, researcher, and teacher. His special fields of work were in applied physics, chemistry, and mechanics. He was a pioneer in electric power transmission and distribution, as well as in electric welding, an art which he founded and highly developed. He was an excellent designer and constructor of electric machinery and apparatus. Many of the machines and instruments used in the early days of the electric power industry were constructed under his design and superintendence. At one time he constructed a 25-centimeter telescope, lenses and all, with his own hands. He introduced and developed the existing prevalent types of electric motor-driven energy meters, registering in kilowatt-hours.

He was a tireless scientific worker from early boyhood. At 17 years of age he was assistant professor of chemistry and at 22 was professor of chemistry in the Central High School of Philadelphia, where, in his leisure time, he made important inventions in electric power transmission.

He never allowed any of his time to be wasted. His was a kindly, engaging, and stimulating, personality. As a leader in electrical engineering he was admired and esteemed by thousands.

Charles F. Scott, president 1902–03—As I recall Professor Thomson, several specific incidents come to mind, trivial perhaps, but characteristic.

One afternoon some 12 or 13 years ago we had been in conference in Boston on some committee matter and found ourselves with a couple of hours to spare. We strolled about the city as he led the way to some particular photographic shops, in his search for films for color photography in which he took great interest. I was never more impressed with the great simplicity and ease of his manner and conversation.

To me, Professor Thomson always was a great electrical pioneer. Later I had met him, principally in AIEE activities. But, in strolling with him through the streets of Boston, I realized that my once mystical hero was very human; in simple companionship, he even insisted on accompanying me to my place of departure.

On the occasion of the celebration of his eightieth anniversary held in 1933 at Massachusetts Institute of Technology, I asked him what it was at the centennial exposition in Philadelphia in 1876 that aroused his interest in electricity. Immediately a smile came over his face and with a twinkle in his eye he said, "I will tell you. There was a Gramme dynamo there from France which operated one arc lamp, and there was another dynamo for electroplating, and another which lighted the lamp on the top of the building." This memory meant a great deal to him as it later on shaped his whole career.

He told me also an interesting incident. "The Rhumkorff coil uses a low-voltage current for producing a very high voltage. I wondered if the process could be reversed and the high voltage current in the fine winding would produce a current in the heavy winding. I was fearful of the results and put off the experiments until I had a coil of my own. I placed the ends of the heavy terminals close together and observed carefully when the Leyden jars were discharged through the fine wire coil. There was a flash and when I attempted to separate the terminals I found them solidly welded together. That was the beginning of my work in electric welding."

His curiosity, his readiness to experiment, his observation, and his practical deductions from his experiments were the beginning of a new art.

And it seems to me that these qualities of simplicity and modesty, and his following along the lines prompted by his curiosity and interest, indicate qualities which were inherent in the man and have influenced his whole career.

Dugald C. Jackson, president 1910–11—Elihu Thomson was great as an engineer, as a scientist, and as a citizen; and in each

category he has received deservedly high recognition. I first met him when he was 35 years old and I was 21, and the impression of his fascinating enthusiasm for the development of electrical engineering and his fertile approach to difficult problems of experimental science has never left me. It has seemed to me that those qualities in Thomson have equally stirred others and led to the wish to honor him that has been displayed internationally.

Being, by intellectual nature, a great inventor, Thomson directed his qualities into human service, and the world is indebted extraordinarily to him for his productions. At least one of his original inventions, electric welding, has become a great industry of itself as well as contributing advantages to many industries. Numerous others of his productions have widely influenced industry and contributed to human comfort. The death of Thomson takes a great man from electrical engineering and a great citizen from the nation.

Gano Dunn, president 1911–12—Elihu Thomson's magnificent scientific and engineering accomplishments have made history. To me his personal influences was as great as his intellectual influence. He always had in mind the inventor, the engineer, the student, as well as the invention, the design and the study. This will forever cause him to be rated as one of our greatest teachers as well as one of our greatest engineers and scientists.

It was to him I early owed recognition that all engineering, notwithstanding its tremendous economic involvements, rests inseparably upon science. His lectures and papers were marvels of exposition. A talk with Elihu Thomson invariably stimulated thought and fired ambition.

His methods of work and qualities of character formed the careers and won the undying affection of large numbers of the generation of engineers who now mourn his loss.

Frank B. Jewett, president 1922–23—Appraisal of Elihu Thomson and his contributions to the advancement of electrical engineering in the light and power field can best be made by those who were his close associates in the many sectors of it which were enriched by his scholarly mind.

Outside the field of our common interest in the welfare of the American Institute of Electrical Engineers, in which our association commenced, my long and close friendship with Dr. Thomson has hardly been involved with things electrical. It has been concerned mainly with matters of general scientific interest and in the problems which came to us as fellow members of the Corporation of Massachusetts Institute of Technology.

Above all other things, however, it has been as an esteemed friend that I have known, admired, and loved Doctor Thomson. His versatile and cultured mind, his simplicity, and his joy in the simple worth-while things of life, which did not diminish with the years, made him a friend to be cherished.

Quite outside the boundaries of his professional life, his death will deprive the world of one of its choice spirits.

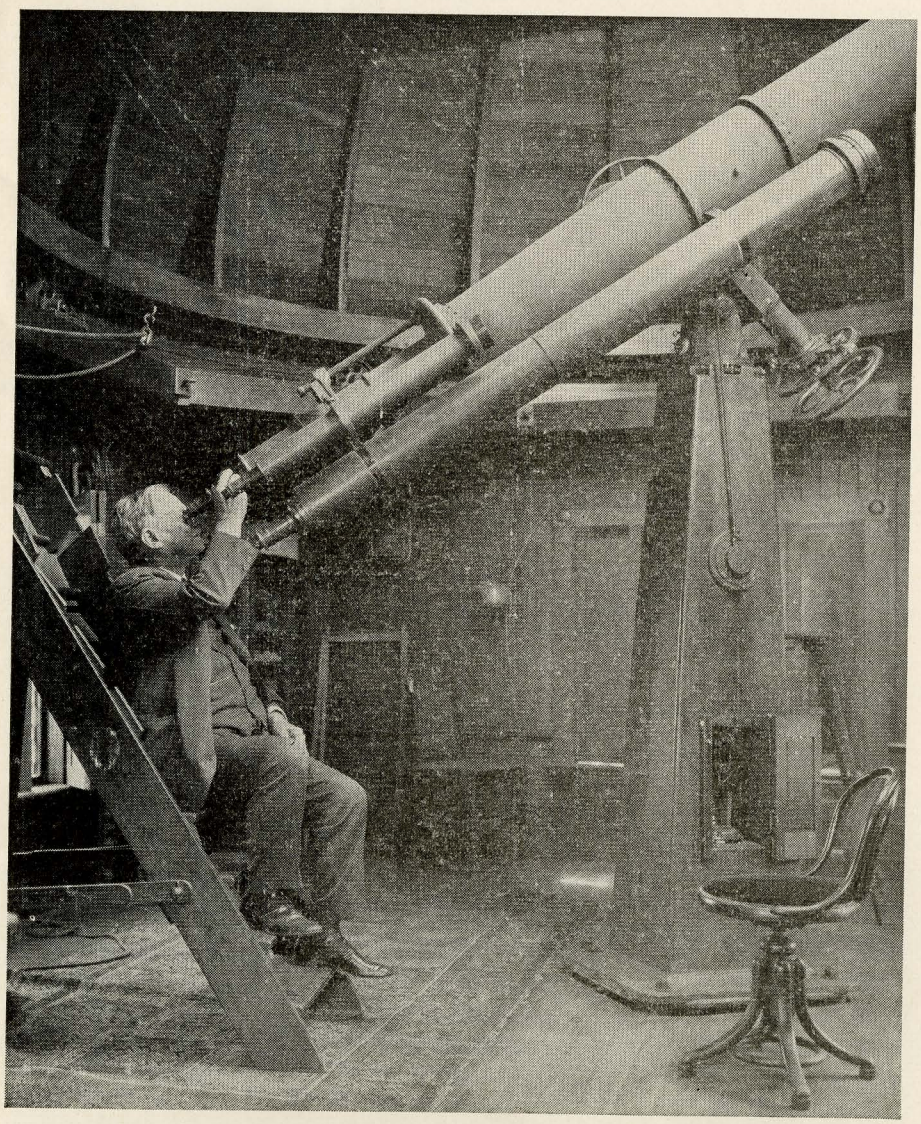
H. P. Charlesworth, president 1932–33—Doctor Thomson's investigations and inventions contributed enormously to the advance of all the engineering arts. However, his contributions went further than these individual activities. In addition to publishing his results and methods, his enthusiasm and technique were passed on to hundreds of engineers, first as a professor, later as a director of the laboratories which bear his name, and finally as a great leader in his profession. His fruitfulness was shared with others whom he had trained and inspired. His whole life was indeed in accord with and greatly contributed to the highest ideals of the engineering profession. It is not surprising, therefore, that his name is among the illustrious group who were the charter members of the American Institute of Electrical Engineers which ever is endeavoring to perpetuate these high ideals.

A. M. MacCutcheon, president 1936–37—One of my greatest regrets is that I did not have the privilege of a close personal acquaintance with Doctor Elihu Thomson, but I am fortunate in having met him. His writings have been an inspiration to me even as far back as my student days.

His deductions, his inventions, and his achievements form a cornerstone in the theoretical structure which represents the engineering knowledge of our time.

His modesty, his cheerful optimism, his breadth of vision, his clear thinking, and his indomitable spirit formed a pattern which all engineers may well emulate.

He was a charter member of the American Institute of Electrical Engineers and its fifth president. We who have followed in his footsteps, looked upon him as an inspiration, a valued counselor, a guiding light.



Elihu Thomson in his laboratory, studying the heavens through his telescope. Astronomy was his life-long hobby

Elihu Thomson as Seen By Some Industrial Associates

Owen D. Young, chairman, General Electric Company—Mr. Thomson was one of the few great pioneers in the electrical field who had the rare good fortune to see his vision become a reality and to receive the appreciation of a justly grateful world for his contribution to the health and happiness of people everywhere. The General Electric Company was always proud of his intimate association with it.

Willis R. Whitney, vice-president, General Electric Company—Professor Thomson was one of the leaders who helped in the estab-

lishment of the Northeastern Section of the American Chemical Society back in '97 or '98. We New England chemists knew him as an expert in our field, just as the electrical engineers recognized him as pre-eminent in their field, and the mechanical engineers as a leader in theirs. Astronomers also knew that he was of their group. He was an all-round scientist.

When the General Electric Company offered me the research work at Schenectady, I was in doubt as to my fitness and as to the quality of the opportunity until I hurriedly consulted "the Professor." He was very kind, as always, and was quite clear that the opportunity offered me was a great one. So I owe a large part of the satisfactions I have enjoyed during the past 36 years to Professor Thomson's kindly interest. Through those years my admiration and affection for him steadily increased, and in his death I feel a great personal loss.

Gerard Swope, president, General Electric Company—Since the very beginning, Professor Thomson was associated with the General Electric Company and its predecessor bearing his name, the Thomson-Houston Company. His accomplishments for these companies and many others throughout the world bearing his name and for the entire electrical industry were many and conspicuous.

His interest in research, his enthusiasm for new ideas, and the advancement of young engineers continued almost to the day of his passing. His memory will long be cherished by those who knew him, and he leaves a fine tradition and inspiration for those who follow him.

William D. Coolidge, director, General Electric Research Laboratory—In the death of Professor Thomson, the General Electric Company has suffered a great loss. Its earliest products were for the most part the offspring of his brain. Great in engineering and invention, he played a most important rôle in the early development of the electrical art. He was a pioneer in arc lighting, was the father of electric welding, devised the first commercial recording wattmeter, and produced by the score the various devices needed for making electric generation and distribution reliable and safe.

He was a true scientist, and by example and precept established the tradition of scientific research in the General Electric Company. When the research laboratory of the company was founded, he served on its advisory council, and, by his experience, wisdom, and fertility in ideas, was of great help to the laboratory in its early years.

His breadth of knowledge, mental alertness, and originality made association with him delightful and stimulating, while his kindliness and simple sincerity won the affection of all who knew him. I was privileged to know him well, and I feel the loss of a great and good friend.

Karl T. Compton, president, Massachusetts Institute of Technology—In his own character and in his great achievements he was one of the truly great men of his century. In all the years of his interest in the Institute [MIT], he displayed a loyal and active faith in the social values of technological education.

Professor Thomson's loss to this institution and all others would be irreparable were it not for the fact that his nobility of character will remain as a lasting inspiration, and his scientific achievements will continue permanently to confer immeasurable benefits to the world.