THE AWARD OF THE FRANKLIN MEDAL TO PROFESSOR ELIHU THOMSON[1]

IT was with the keenest delight that I learned that Dr. Elihu Thomson had been selected to receive the Franklin Medal for this year, and I deeply appreciate the honor of being asked to participate in the happy event.

The secretary informs us that the award of the Franklin Medal to Dr. Thomson is "in recognition of his pioneer work in the field of electricity and electrical engineering and of his numerous inventions in these fields."

Fortunately, Dr. Thomson's achievements in the field of electricity are so well known that I need consume but a few minutes of your time to refresh your memories, or to indicate how wise and fitting has been the action of your committee in making this award.

Dr. Thomson has long been recognized as one of the world's great pioneers in the electrical field, and it is well known that his contributions have been continued from the pioneer days to the present time, so that, after fifty years of strenuous and fruitful effort, he is still recognized as a leader in his chosen field.

His inventions and engineering work have been the basis of a great manufacturing and engineering industry, and are set forth in some seven hundred United States patents, mostly relating to electrical subjects.

Dr. Thomson was a pioneer in the field of alternating current, and it is particularly interesting that in the Franklin Institute, in this very hall, at a series of lectures given in 1879, he exhibited an alternating current dynamo of his own construction from which he ran two transformers with fine wire primaries connected in parallel to the dynamo-line, and the secondaries performing the local work. This was the prototype of the modern transformer system.

This pioneer work was one instance of many where Dr. Thomson's ideas were years in advance of the world's readiness for their reception, and, recognizing this fact, he turned his attention to the development of a system of arc lighting.

His famous 3-coil arc dynamo, with its automatic regulator and other novel features, formed the basis of the successful lighting system put out by the Thomson-Houston Electric Company in the year 1880. This machine was remarkable for its simplicity, ruggedness, flexibiilty and efficiency. It was the first machine to be entirely automatic in its operation, and it would maintain an absolutely constant current flowing in a circuit over the extreme range from full load to a complete metallic short circuit—a feature possessed by no other machine at that time.

He was the first to utilize a magnetic field to move an electric arc. This idea took many forms and was first applied in 1881 in connection with a lightning arrestor for his arc light system. This principle was immediately extended to the construction of switches in which the magnetic field was used to interrupt the arc formed upon breaking a circuit. All of these devices, known as "magnetic blowout devices," were of fundamental importance and are still used on an extensive scale, notable applications being found in the controllers for electric street cars, electric trains for elevated roads, and on large electric locomotives.

Later, returning to the alternating current field, he was the first to use oil as an insulating material in transformers, and to make the high tension alternating current system safe for human beings by introducing the practice of grounding the secondaries of transformers and distributing circuits. In his notable discovery of the so-called alternating current repulsion phenomena, he laid the basis for commercially successful alternating current motors.

A patent granted in 1883 for a reactive coil clearly points out the distinction between a resistance and a reactance, and sets forth the practical value of the reactive coil in regulating and controlling alternating current circuits.

He made the first very high frequency dynamo in 1890, with a frequency about forty times higher than that hitherto produced in any dynamo. Shortly afterwards he originated the method of producing a high frequency alternating current from a direct current by shunting the arc with inductance and capacity, and published at the time a description of this beautiful apparatus and the theory of its operation.

He also made the first high frequency transformer, and, as a result of brilliant scientific investigations, developed apparatus which was afterwards utilized in wireless telephone and telegraph work.

His universal electric meter for recording direct and alternating current energy and his new electric measuring instruments of all kinds made possible that definite and accurate knowledge needed for the orderly growth of the electrical business.

But Dr. Thomson was not satisfied with even these great contributions to a developing art. In 1886 he gave us a new art—the art of electric welding by the incandescent method. This discovery and its development, spot or line welding, are used for a multitude of services, from the joining of fine wires which lead current into the incandescent lamp or the radio valve,

[1] Address by E. W. Rice, Jr., honorary chairman of the board of directors of the General Electric Company, previous to the presentation at the Franklin Institute on May 20.

to the construction of the hulls of great steamships without rivets. Metals previously unweldable were easily joined, and complicated and expensive mechanical methods were made simple, cheap and reliable.

He made many important contributions to the field of radiology, and was the first to make stereoscopic X-ray pictures.

He did early pioneer work with the electric resistance furnace and developed a method of manufacturing that beautiful material, fused quartz, by electrical means, which gives every evidence of being the best yet devised.

He made the first important research into the nature of the laws governing the electric arc. The results of this investigation were published in the Franklin Institute Journal in 1879, and disclosed among other things the important fact that the resistance of the arc varied inversely with the current, which accounted for the instability of an arc unless operated from a circuit having constant current characteristics.

During the years since this first research he has made many other scientific researches to some of which I have briefly alluded, and has contributed hundreds of articles on scientific and engineering subjects.

This incomplete and imperfect sketch will, perhaps, serve to indicate the extent and variety of Dr. Thomson's knowledge and the range of his mental activities, and the ingenuity and great practical value of his work. He has not been content to make some astonishing discovery or invention and then lapse into comparative quietude, but during his entire life has been a continuous worker. Thomson, perhaps more than any other inventor since the days of Henry and Faraday, combines in his person profound and accurate scientific knowledge with most extraordinary technical skill.

He has received numerous honorary degrees, Master of Arts, Yale, 1890; Doctor of Philosophy, Tufts College, 1894; Doctor of Science, Harvard, 1909; Doctor of Laws, University of Pennsylvania, 1924; Doctor of Science, Victoria University, Manchester, 1924.

Dr. Thomson received the Grand Prix in Paris, 1889, and again in 1900, for electrical inventions, and was decorated by the French government as an officer of the Legion of Honor. In 1904 he received the Grand Prix at St. Louis. He was given the Rumford Medal in 1902, and in 1910 was the first recipient of the Edison Medal. In addition, he has been awarded the Elliott Cresson Medal, the John Fritz Medal, the Hughes Medal of the Royal Society, London, and last year the greatest of all English medals, the Kelvin Medal.

It would therefore seem singularly fitting that he should now be the recipient of the Franklin Medal, given by the Franklin Institute, the scene of his earliest pioneer work in the electrical field. It is with the greatest pleasure that I present to you Dr. Elihu Thomson for the receipt of the Franklin Medal.

WILLIAM JAMES BEAL: AN AMERICAN PIONEER IN SCIENCE

THE student who now-a-days begins the study of botany in a laboratory with its fine equipment of microscopes, microtomes, ample laboratory space and an abundance of help on the part of laboratory instructors would find little in common with the early life of the late Dr. Beal, who began his botanical studies at a time when the idea of laboratory work by the student of botany was unheard of. The men of Dr. Beal's generation had to dig out their botany almost alone, and without most of the things now considered to be absolute necessities. The early scientific training and inspirations of his life are told most sympathetically in a little volume entitled "An American Pioneer in Science" and published privately by the authors, Ray Stannard Baker and Jessie Beal Baker, the latter the daughter of Dr. Beal.

Born in Adrian, Michigan, in 1833, Dr. Beal lived the life of a pioneer in the then frontier. Indians still lived in the vicinity and the woods abounded in wild animals. Schools were few and newspapers and books exceedingly rare. Yet the young pioneer gained what training was possible in the schools and academies of his vicinity and entered the University of Michigan, graduating with the class of 1859, all but one or two of whose members he was destined to outlive. He became a teacher in the Friends' Academy at Union Springs, New York. In the early sixties he entered Harvard, studying under Dr. Asa Gray, Dr. Charles W. Eliot and Louis Agassiz. The last named was the one whose impression was greatest, for he introduced Dr. Beal to the laboratory method of study, a method not then used at Harvard by either Eliot or Gray. After two years as professor of botany at the old Chicago University, Dr. Beal was called in 1870 to the Agricultural College of Michigan, serving as professor of botany, horticulture and forestry until gradually the departments of horticulture and, later, forestry were established, thus leaving him to his especially beloved botany. Following the inspiration gained from Agassiz, it was not many years until Dr. Beal introduced the laboratory method of instruction for botany, at a time when this was a startling innovation.

Besides his investigations and teaching work in botany, the subject of forestry received great attention. Dr. Beal was one of the first to preach conservation of forests, although that word was not then used. He lived to see the day when his predictions came true and many of the methods suggested by him were brought into practice. He was always more of a stu-