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ONE OF THE "SONS OF TOM"

Of "the sons of Tom in science," as the illustrious clan was once described, America possesses a versatile representative. Our own national Thomson is a personage of international renown. He is, truly enough, one of the great pioneers of American electrical progress; but he is no less truly a pioneer in pure science, a contributor to the vast reservoir of basic human knowledge; and thus his influence, like that of all such intellects, transcends the boundaries of the nations and will endure beyond the calendars of the years. Observed from still another point of view, Elihu Thomson has been an inspiring stimulator of inquisitive human minds. He is the ideal teacher, unfailingly patient, mentally magnetic, in personality endearing. To his name, through the vicissitudes of six decades, has affectionately clung the title of "Professor."

Responsive to such considerations, one easily appreciates the fitness of the recent occasion which honored Professor Thomson upon his eightieth birthday. For a great technical school, an institution of scientific learning, to conceive and conduct such a program of recognition was logical as well as appropriate. In particular, the Massachusetts Institute of Technology—the birthday host—has had certain working affiliations with Professor Thomson which cause it to look upon him as definitely a part of its life and affairs. He was its acting President for three years and for a long period has been on the executive committee of the Corporation of the Institute, as well as nonresident member of the Faculty. These associations have represented his continuing official bond, throughout these latter years, with the profession of teaching.

During the remarks which followed the testimonial dinner, it was apparent that Massachusetts Institute of Technology has never lost sight of Elihu Thomson the teacher, while consistently appreciating Elihu Thomson the scientist and engineer. Dr. Karl T. Compton, president of the Institute, who presided, first asserted his belief that Professor Thomson has contributed more than any other man now living to the creation of what has been called the "age of electricity;" and, a little later, expressed his no less positive conviction that Professor Thomson's "lifelong effective participation in educational work" was rooted in his interest both in the work and in young men—the unmistakable motives of the teacher.

Dr. Vannevar Bush, dean of engineering of the Institute, was still more outspoken in appraising this aspect of the many-sided Elihu Thomson. Here is a man, the dean pointed out, who has been scientist, inventor, organizer, engineer, man of business, and yet has remained for sixty-odd years, by temperament and attitude, a professor. He has caused an electric arc to alternate in a magnetic field; he has made one piece of metal where there were two before. "But I venture the thought," Dr. Bush went on, turning to the guest of honor, "that these were not as stimulating or as lasting as the satisfaction which was yours when you first caught in the eyes of a youngster that gleam of fire which told you that a spark of your own wisdom had transferred to another mind."

And then the testimony at first hand of Edwin W. Rice, Jr., formerly president of General Electric. In those long ago yet unforgotten days in the Philadelphia high school, Rice was the pupil and Thomson was the teacher; and in reminiscent acknowledgment of the old relationship Rice alluded to Thomson across the banquet table as "my professor," recounting the thrill of learning from him not only at that period in the classroom but through later adventurous years when they were organizers and business men together in the dawn of the electrical industry.

Has Professor Thomson always taught specific subjects during these sixty-odd years? Did he impart definite, clear-cut data, sharply defined rules and formulas—and nothing more? He himself remarks that he has always been a teacher. "One of the greatest pleasures of my life," he affirms, "has been to share what knowledge I might have obtained freely with earnest students of the subjects of which I might have accumulated information." But this knowledge repeatedly was contained in stirring new ideas. Thomson, as remarked by Owen D. Young, chairman of the board of General Electric, has been essentially a man of ideas.

"The man who lives with ideas, as distinguished from things," said Mr. Young, "has a life which is an exciting serial, in which he is always anticipating the new instalment. His value is not impaired by age, so long as he retains these qualities." And then he adds that by this criterion "none will deny that Professor Thomson is young." None will, indeed; and ideals of learning such as these are, of course, desirable to perpetuate. The assurance that these "ideals of creative scholarship and productive service" will be definitely and worthily carried forward is to be found in the announcement of the Elihu Thomson Professorship of Electrical Engineering, which will be endowed at Massachusetts Institute of Technology as soon as conditions warrant.

This admittedly inadequate summarizing of the intellectual background possessed by this eighty-year-old "young man" facilitates, perhaps, a ready comprehension of his numerous technical achievements, which have made him a molder of our "age of electricity." Ideas began to crowd forward early in the career of this vigorous mind. As a remarkably young high-school professor he advanced the theory, in a series of public lectures, that all forms of electricity are identical manifestations—at that period a new idea indeed to folk who had scarcely ever seen an electric light. The idea of electric lights as an established factor in practical life was itself unique, and Thomson's plan for applying it took on particular significance, more apparent in technical circles than it was to the lay public, because of his original ideas. It was the full tide of ideas that enabled him to produce an arc-light system that was remarkably reliable. The mere by-products, so to speak, of this general program of endeavor were new even to the point of prophecy; for the idea of the three-phase alternator and the idea of the parallel-connected transformer were both born of Thomson's experimental work with his system of electrical illumination.

His incessant experiments were prompted by his ideas; and the experiments themselves suggested new ideas. He quite clearly understood that Edison's "etheric force," so-called, was in fact electrical; and in confirming his belief, in 1875, with his co-experimenter, Professor Edwin J. Houston, he produced oscillating discharges, or sparks, which set in motion electric waves passing through space—actually a perfect demonstration of wireless transmission twelve years before the work of Hertz, whose name eventually was applied to such waves. During the public lectures already mentioned, which were delivered at the Franklin Institute, he performed an experiment which to his quickly discerning observation revealed the clew to electric resistance welding, commercially introduced some years later. And on this idea alone there was founded a new offshoot of American industry.

His development of the useful magnetic blowout principle occurred during a period abounding with ideas. It has been recorded by Rice that Professor Thomson declared, to Rice's amazement, that a potential of even two thousand volts would cause an electric spark to jump through the air; and that Thomson understood clearly that if two alternating-current three-phase dynamos were connected by a three-phase circuit one could drive the other as a motor—a statement trite enough today but challenging to electrical ears of the eighteen-eighties.

Thomson had already disclosed his thorough grasp of alternating-current fundamentals. He had filed a patent application during these early years on his induction coil (transformer) system, thereby precipitating one of the longest conflicts in the history of the patent office. It is quite certain that he would have introduced a perfectly practical transformer and method of circuit connections had no one else done so. Actually he was a close contemporary of William Stanley in doing this; and his system possessed the distinctive quality of safeguarding the user of electric current by his idea of grounding the secondary coil of the transformer. This was such an innovation at the moment, and its humane significance was so little realized, that it was twenty years before the Board of Fire Underwriters made the practice mandatory in electrical installations.

Professor Thomson's vision of the practical possibilities of alternating current was again impressively apparent in his famous discovery, by continuous experiment, of the repulsion principle. The formal announcement of this event was contained in a paper read by him on May 18, 1887, before the American Institute of Electrical Engineers and entitled "Novel Phenomena of Alternating Currents."

The action which Thomson had observed was defined by him as "electro-inductive repulsion," and was quickly understood as fundamental in that branch of alternating-current development. From these experiments sprang the induction motor for single-phase work and the repulsion motor, both by itself and in combination form. It lessens the value of Thomson's work in no respect to record that the ultimate development of the new principle was carried out largely by others. Indeed, the paper of 1887 stimulated numerous designers to work with alternating-current apparatus. Tesla once declared that this paper suggested to him all the latent possibilities of induction motors—a field of design in which he later became preëminent. It was a perfect example of the teacher imparting to others his own new and valuable ideas.

The mental flood-tide continued. None of the "sons of Tom in science" was ever more prolific of ideas than Elihu. Only a few years after his alternating-current contributions he produced the first practical wattmeter in this country, and shared with Aron, a European inventor, the Paris prize of 1890, amounting to 10,000 francs. His high-frequency dynamo; his oil-immersed and oil-cooled transformer; his constant-current transformer, a further application of the repulsion principle; and, aside from the electrical field, his work with fused quartz, especially its application to astronomical mirrors; his continuous centrifugal separator, leading to the centrifuge as employed in biological laboratories; and his fluid pressure engine (later introduced commercially as the "uniflow engine")—all these, and others as well, are practical ideas that have come forth from the thinking and experiments of this single technician. His idea of a new type of mirror for large reflecting telescopes, to be constructed from fused quartz, is itself quite revolutionary as to its possibilities. He has studied and worked with fused quartz, or silica sand, for so long that he is perfectly familiar with its inherent properties, as well as its behavior under various modes of treatment. He has learned how to fashion it into different shapes and adapt it to particular usages. He has been confident for years that it is an ideal substance for reflecting mirrors such as are employed in the telescopes of modern astronomers. He has predicted that such an innovation would inaugurate a new era both in the design and structure of the telescopes themselves and in the study of the heavenly bodies which, with their powerful aid, may in future be prosecuted.

Thirty years and more have elapsed since he first entertained the idea that this substance, by reason of its very slight expansion from temperature changes, might prove to be an ideal material for such a purpose. A simple experiment was sufficient to give weight to his theory. It was merely the procedure of throwing the image of a small point of light upon a little slab of fused quartz, then holding a flame of moderate heat at the back of the slab—and repeating the experiment with a similar slab of glass. In the case of the fused-quartz mirror, the image of the artificial star remained clear and sharp, even after the back of the slab had become so hot that it could hardly be touched, whereas the application of this slight heat to the back of the glass mirror caused an immediate and total distortion of the image.

Since then Professor Thomson has made such progress in his fused-quartz investigations as to become an authority on the subject. In the Thomson Research Laboratory at West Lynn (Mass.), fused quartz has been fashioned into various forms for astronomical and other research purposes, and for commercial usage as well. Thus his faith in fused quartz has been justified.

A succession of patents resulted from this continued activity. Many might have supposed that Professor Thomson would not continue to provide business for the patent office after passing seventy. Such was not the case, for his career has finally made him one of the most notable patentees in America. At every period of his mature life he has been producing patentable ideas. All told his inventions have caused the issuance of 700 patents; but to him the patents doubtless have held a minor interest by comparison with what he calls "that joy of joys, the joy of achievement." Well has he practiced his favorite motto: "Prove all things and hold fast to that which is good."

Long since the world of science has expressed its appraisal of this particular Thomson. No other man has ever received all three of the great scientific honors of England—the Hughes, Kelvin, and Faraday medals. In this country the first award of the Edison medal went to him. The four leading American engineering bodies have been unanimous in bestowing upon him a tangible evidence of their regard.

Among those whom L. B. Buchanan and Dr. Harvey Cushing have called "sons of Tom in science," Elihu might be defined as the genealogical balancer, in contrast to, or perhaps in complement to, the first of these sons, Benjamin, later called Rumford. Benjamin Thompson was born an American but achieved scientific immortality in England, where his work included the founding of the Royal Institution. Elihu Thomson was born an Englishman but has risen to fame in America, where his work has led, with that of Edison, to the founding of General Electric. Perhaps these two respective "foundings" might be taken to delineate the essence of each man's influence. Benjamin, although accomplishing much that was practical, was also a leader in theoretical thought and in pure research. Elihu, although a typical example of the truth-seeker in science, has been a pioneering genius in developments directly reflected in practical applications of every-day utility.

In the circumstances of their births and subsequent migrations in diametrically opposite directions, as well as in their careers in each other's native lands, these two men exemplify that strong bond of union which the "sons of Tom in science," mostly by their scientific universality, have stretched across the great waters between the two principal countries of Anglo-Saxon origin. JOHN WINTHROP HAMMOND