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CHARLES PROTEUS STEINMETZ AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS[1]

By DUGALD C. JACKSON

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THIS is the anniversary of Dr. Steinmetz's birth. He was born on April 9, 1865. In later years he was my friend, as he was also of many of you who are here to-night.

Also, about this time in the month of April fifty years ago the first formal movement was made in New York for establishing the American Institute of Electrical Engineers. It was my good fortune to attend in Philadelphia a few months later its first formal meeting for the reading of papers, although I was then still an undergraduate in Pennsylvania State College. The meeting was held in Philadelphia on account of an electrical exhibition being supported there under the auspices of the then sixty-years-old Franklin Institute.

I have been asked to speak for both of these, to us, important anniversaries. With respect to the American Institute of Electrical Engineers, I am requested to provide some words additionally on why and under what circumstances the Institute proves of value to the young men who have ambitions in the field of electrical engineering.

I remember well the joint Pittsfield and Schenectady meeting of the American Institute of Electrical Engineers, held in February, 1911, when I was president of the Institute. Steinmetz had been president nine years earlier; but he was actively the

[1] Address at dinner at Schenectady, N. Y., held on the anniversary of Steinmetz's birthday and in celebration of fiftieth year of the American Institute of Electrical Engineers, April 9, 1934.

patron of that meeting of February, 1911, and he gave deep attention to according opportunities for the younger men to enter the discussions as well as personally encouraging them to do so. I have hanging in my office at M. I. T. a picture of that meeting, taken on a wintry porch either here or at Pittsfield, in which Dr. Steinmetz makes a striking figure near the center of the front row. It may help you to fix your electrical engineering chronology for me to say that in that same year I had the pleasure of presiding in Pittsfield at a dinner in celebration of the twenty-fifth anniversary of Stanley's production of his transformer. I still retain on my desk a small replica of that transformer, then presented to me.

Steinmetz was a man who partook of the meat and honey of rigorous thinking and hoped that others might do so. Any man who occupied himself primarily with affairs inadequate to his ability made proof to Steinmetz of an inappropriately tuned mind but which mind might perhaps still be brought into harmony; and Steinmetz therefore was constantly encouraging the young men around him to lift the level of their ambitions and to cultivate real achievements. To make a capable engineer, a capable scientist or a capable inventor a man needs at least two or more of the following qualities: (1) Discriminating mathematical (*i.e.*, analytical) powers with which to conduct exploration; (2) imagination for arousing vision of a promised land; (3) curiosity for inciting experimentation; (4) penetrating powers for observing results of analysis or experiments; (5) synthetic intelligence to support invention. Steinmetz possessed all these qualities and added thereto a warm sympathy toward those in the stream who were struggling in the current toward achievement, and also toward any unfortunates who had slipped into the backwash of misfortune or who had never known the opportunity of achieving.

This quality of sympathy, which was added to his gift of clear thinking and lucid expression, made for him many admirers and followers who otherwise might not have thought about him. In his later years he strove to bring people to a sense of cooperation which would lead to full mutual welfare, as the contests between selfish pride of station and unselfish but superficially sentimental social attitudes cause turmoil which in his opinion prevent sound social processes from becoming firmly seated. I will have to confess that it requires a nice balance—this relation between individual liberty on the one side and the individual restraints that are necessary to assure fullest mutual welfare on the other side, and the balance is as yet to be discovered. Republicanism calls for unity, not for uniformity. The unity in this case is a unity of purpose, whether determined by some select class, as in ancient republics such as the Republic of Rome, or by a complete democracy of the sane and mature citizens, as in modern states like the United States, Great Britain and France. Unity of purpose in the latter situation relates to the mutual interest and welfare of all classes of citizens; but there may be wide differences of opinion regarding the best ways of accomplishing the purposeful end, and much argumentative controversy may stand in the way of progress.

It was not Fortune that made Steinmetz. The only time that I think of in which Fortune directed Steinmetz's life was when authorities of Germany declared his activities to be obnoxious and he fled to America at the age of 24, to fall into the sympathetic hands of Mr. Eickemeyer. Each following part in the pattern of his life came into its place as a consequence of his own intellect and industry. Steinmetz came to America at a period when the productiveness of processes and machines was establishing for itself a strong part in the support of man, in supplement to the old-time productiveness of the earth, its waters and its atmosphere. He did not fail to embrace the opportunity of his period. He promptly exhibited his ability as an original and resourceful experimenter by publishing his results on hysteresis phenomena, and shortly thereafter showed his analytical grasp by demonstrating the usefulness of algebra of complex quantities in electric circuit computations. These were but incidents in a life of steadily growing fruitfulness.

Lord Avebury tells of an inscription not less than 5,800 years old in which the floor of heaven is described as made of iron. This is an interesting change of emphasis from the pearly gates and golden streets of modern evangelists, but it is not a greater shift than the changes in human relations in the same period, which have been made for the good of civilization by scientific discovery and invention. "Tiny scales make the great skin of the dragon," says a Chinese proverb, and we have the collective influences of successive discoveries and inventions which together make the great body of engineering that has lifted the human race out of a depth of degradation and misery that none of us here can easily conceive, so that we now (even at our worst) are all in relatively considerable ease. In spite of this achievement in favor of humanity, engineering (as an embodiment of science and invention) has to align its path of further progress with solicitude so as to avoid the evil anticipations of the Cassandras and also to still the lamentations over the past of the Jeremiahs.

Scientific observation, discovery and invention forerun social organization; simple social organization foreruns organized government; but organized government then becomes necessary to maintain justice between man and man, ensure domestic tranquillity, provide for the common defense, promote the general good, secure general liberty (I paraphrase a well-

familiar definition). The existence of organized government connotes regulations or laws, and the object of governmental laws is to assure that human beings may live in propinquity and agree together without the old-time history-long recourse to bludgeon, dagger or gun. However, neither justice, domestic tranquillity, mutual defense, common good nor general liberty can be assured when depth of poverty and misery strikes at the greater portion of the population of a nation. If you wish to know a little of depths of poverty which in actuality are beyond your evilest dreams, I commend you to the reading of Kipling's book called "Kim," which treats in part of the life of the natives in Northern India with its immeasurable poverty and attending lawlessness of the many contrasted with the inordinate power and wealth of a few, or Mrs. Buck's book called "Good Earth," which deals with the misery of the simple farmer and the contrasts of life on the fertile plains of China. The contrasts between wealth of the high and misery of the lowly which are described in those books seem to me no greater (and perhaps they are not so great) than the like contrasts that were observable in the European hemisphere three centuries ago, which was before the influence of scientific discovery and invention began to be felt in the lives of western men through the effects of machines and manufactured products that leveled up in large degree the living conditions of the lowest coteries of population without so large a proportional influence on the state of the wealthy. This influence is yet but little felt in the plains of India, except for the effect of rail transportation in suppressing famine; and the influence is felt in China only on the eastern edge of its great area. Those who have argued themselves into believing that the present period is a "sunk epoch" for us of the western world have merely failed to observe the facts accurately. Much that has been written as a comparative condemnation of our present modes of life is as shot full of error as would be a book on details of the "machine age" written by a man who was so ignorant of those details that he did not know enough to diagnose a water-dripping kitchen faucet as indicating need for a new washer.

The world has not yet come of age. It is still in the fighting, hoodlum stage of youth. For illustration: It is less than 300 years since naval authorities of Great Britain arrogantly demanded that ships of all other nations should dip their flags when passing British naval vessels. It is less than 200 years since Britain alienated her American colonies by placing prohibitions on colonial manufacturing. It is less than 100 years since Great Britain claimed the right to arbitrarily stop and search on the high seas the naval vessels of other nations. It is only 20 years since the whole western world in an epidemic of rabies ravaged the area of Europe.

The conception of a community tendency among human beings, in the origin of a civilization, is a child of engineering; but the development of this child in the hands of the hoodlum human race has been a wildly unguided one. We engineers having provided by our observations and inventions the opportunity for propinquity, what are we as human beings going to do for the prevention of mental and physical frictions which grow out of mutual contacts of independent individuals, and how are we at the same time to successfully maintain the intellectual independence of the man units? The description of a corpse does not compose history; nor does unrestrained sentimentalism make a useful guide to the future. History as seen from our era is a surging flux of men's blood, and its recital must be strong with movements and passions. The future, however, must be foreseen with many of the passions held under restraint; because liberty, independence and freedom, in the political sense, are closely bound up with a skein of restraints on the individuals who compose any community of interest. Recently, for the American Association for the Advancement of Science, I made an address on the "Origins of Engineering." That subject is full of the romance of the transfer of physical labor from human shoulders and laying the same labor on machines, associated with an increase of emphasis on human intelligence in contrast with brutality; which transfer is still going on, and we are all profiting by it in the Western nations. This transfer and change of emphasis is bound up in the tale of the origins and growth of engineering. I would like to make an address for you on the services which engineering has performed in advancing civilization and improving the conveniences associated with living, and another one on the abuses of engineering which have been introduced by many betrayals at the hands of civilized men, but each one alone of these topics is too extensive for a dinner speech, and so I must refrain. Besides which, my allotted speech time, like a salted silver mine, is rapidly approaching exhaustion.

However, you now may be asking yourselves what all this has to do with the young men and the American Institute of Electrical Engineers. Good! A question asked of oneself calls for an answer from oneself, and you are bound to carry on; but I will intervene with some suggestions to help the process.

The engineers are responsible for most of the factors (other than preventive medicine) that have lifted conditions of living out of the slough in which those conditions still lay at the time of the Middle Ages. We, as engineers, have been responsible for the instruments that have performed the service and that

continue in performance. We have been primarily interested in the scientific and technical questions relating to the production arising from those instruments, but we have had little interest in the social organizations under our governments and have paid little attention to the ways in which our productions have been used. We are now under sharp criticism. Obviously, the criticism is justified, for we should recognize that we are under an obligation to give more attention to relations with our fellow men. Here is one of the greatest opportunities offered to you younger men by the American Institute of Electrical Engineers.

The call from the world is for you to become more than expert men of science and technicians, and to add to that important quality the equally important one of moulder of opinions and leader of men. You can find no better schooling for that end than comes from active participation in the meetings of the American Institute of Electrical Engineers, giving equal parts of your attention to its scientific and professional sessions and to its organization business. In those scientific meetings you meet your peers, who will not tolerate hazy thinking, and you will become habituated to applying sound processes of thought regarding your associations with your fellows and thus it may become easy for you to apply sound thought-processes equally to scientific and to social matters, unusual though the latter is for the majority of people; and you will thereby become influentially serviceable to your community. Moreover, through active relations with your peers you will have it borne in on you that abstract principle is no monopoly of one man or of one party, but (like abstract justice) principle is arrived at by the combined thought of the most earnest and judicial-minded. That it is arrived at by fair compromise between honest minds who are competent in sound thinking, you will discover if you will impartially participate in the meetings.

These things of the intellect that are so much a part in the making of an influential man of the world will come to you out of the activities which I am commending to you, while you are at the same time retaining and improving your scientific and technical capabilities through the association with men of like capabilities. These are the most broadening of experiences, and the young man who neglects such opportunities in order that he may live a hermit-like and unsociable life, or that he may associate with groups of foggy-minded men or men of lesser ability than his own, is sacrificing one of the major privileges of his early years of life. Moreover, a young man profits by such activities in a multiple proportion to the attention with which he regards them, always with the reservation that they come in importance after the duties which he is paid a salary to perform. The young man in the electrical engineering branch of work who carries on his part in the Institute, in all of its affairs—papers, discussions and business duties (including its finances)—doing so with due consideration of the limitations which nature imposes regarding his time and his physique, and who encourages others to likewise do their reasonable parts, finds in later years that the American Institute of Electrical Engineers has been one of the parents of his progress. It was in recognition of this last fact that Dr. Steinmetz constantly encouraged the younger men to take active part in affairs of the Institute.

In the preceding I have referred to section finances. Money and credit must continue as the attending handmaiden and intermediary of man's efforts to exchange his abilities, time and goods for elements which he expects to afford him profit or pleasure; and it is desirable for a young man to secure self-reliant responsibility by dealing with financial relations from which he himself receives no direct money compensation. Reliable management of the section finances affords the opportunity and experience. In all this we must also remember that the effectiveness of the territorial sections arises from the fact that they are a part of a great national professional organization; and it is desirable to play one's part in the national affair.

The Institute now has joined with other professional societies in the engineering field to establish what we call the Engineers' Council for Professional Development, and through this organization you will later find further opportunities for guiding your own development. You can not grow unless you have the *will* to develop, and then your development is in your own hands and will be successful if you are judicious in appraising yourselves.

Dr. Steinmetz is no longer with us. A life that is over, is over; but the influence of deeds of merit is permanent, and there are many of the established and older men among you who emulate Steinmetz in encouraging you young men to actively embrace your opportunities in the Schenectady section. Taken in the main, man is still a primitive. Perhaps he always will be, since each individual human being grows out of a child, and the life of each individual is short for formative influences to have a large effect unless they are energetically embraced. Thus it is that each one of you young men should try to make the most out of the opportunities which lie before you in the Schenectady section and (through it) in the national organization.

Some of the things, collateral to your specific scientific or commercial work, to which you younger men

should give a fair amount of rigorous thought are such as the following—I choose my illustrations from engineering, but take them from outside of electrical engineering so that we shall not fall into controversy over the suggestions:

The railroad is a contribution by engineering to civilization: but is it good to spend money to ship cream to Massachusetts from the middle west by railroad and thereby depress the price paid to New England farmers below the level of fair profit and without providing any offsetting advantage to urban consumers? Is it good to cross-ship cranberries from Cape Cod into Wisconsin, which is a cranberry producing state, and from Wisconsin eastward, with an excess of shipping cost to be absorbed by producers and consumers? Is the country being misled by the many times repeated statement that our tremendous expenditures for hard-surfaced roads are being made for the farmers' benefit; and even if it is "good politics" now, is it ethically right and for the general good to spend from ten thousand to thirty thousand dollars a mile for secondary highway networks when half the money might suitably service the particular purpose and *any* money for the purpose has to be raised by difficult taxation, either in the locality concerned or over the nation?

These are typical illustrations from the extraordinary range of eccentricities of commercial distribution and of expenditures for permanent plant which have arisen through uncontrolled and thoughtless use of the engineers' priceless gift to civilization of modern transportation. Substantially every other engineering contribution to civilization is similarly abused. These eccentricities produce annual wastes of man-hours and of money. Are they either good commerce in the long run or sound political economy? Do the people of the nation possess sufficient wealth to support thoughtless community waste? Can we introduce restraints into such activities sufficient to cure or ameliorate the wastes and yet not cause undesirable restraints on the cherished independence of the individual beings that compose the community?

Until we engineers as individuals and as civic groups can apply accurate and impartial thinking in reflecting over these and many similar questions which essentially relate to those engineering applications that influence convenience of life throughout the nation and profoundly affect the economic condition of the citizens, we still have some important feature lacking in our education. We must fill in this lack, but we must accomplish the purpose without deteriorating our greatness in engineering science and the arts. While trying to do this, we must not forget that the activities of the average professional reformer or unreflective enthusiast not infrequently are as inimical to the general community welfare as the activities of the average professional demagogue. The two persuasions therefore ought to receive equally exacting scrutiny before their measures are accepted or supported.

OBITUARY

HOWARD AYERS

THE passing of Dr. Howard Ayers last October has been noted already. Critical valuation of his contributions to the comparative morphology of some of the lower vertebrates may be left to those who work intensively in the field where he was a contributor and controversialist.

Some of us who worked with him in the laboratory day by day would like to testify to human values. Ayers possessed in marked degree a kind of spiritual intuition, which led him, after an hour in a laboratory full of students, to crook his finger at one, take him to his office for an hour and send him forth an enthusiast for biological investigation. No less a figure than Dr. Erwin F. Smith confessed to such inspiration in a first year of biology with Ayers. In the classroom, his uncanny ability to see in the subject under discussion just what phases had escaped the student and bring those points up for discussion was phrased in his characteristic way, "What do they take me for? Do they suppose I would waste my time asking a question which I thought they could answer? I ask questions to make men think."

His laboratory was a workshop which was almost entitled to the sign, "We Never Close." A graduate student who held the watch on him got the retort, "Young man, you belong here when you don't have to be elsewhere." Again, he called in a medical student—"Mr. M., I believe the Almighty put every man into the world for a purpose. If he finds out what that purpose is, he becomes useful and successful. He certainly did not intend you for a doctor."

Howard Ayers was not popular, but no man who came into intimate contact with his broad scholarship, his enthusiasm for work, his intolerance of sham or pretense, could fail to recognize his claim for leadership, based like that of the knights of old on being always a little the best man on the job. Such men went away from Ayers' laboratory better and more useful for the contact.

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