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THE ENGINEER AS PHILOSOPHER AND CITIZEN

Lecture of Cyrus Eaton
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(Biographical Information on Cyrus Eaton is Attached)

This is the age of the scientist and the engineer, so that I am deeply honored to have this opportunity to talk to a distinguished audience drawn from the world's largest and most renowned scientific and technical school.

I find added pleasure in the occasion because it brings me to Boston, which it is always a special event to visit. My ancestors arrived here from England in 1620 and 1640 and, although some of the family later moved to Nova Scotia, succeeding generations have remained faithful to New England traditions. Longfellow, with his sympathy for mankind, was the first poet whose lines I learned by heart. Emerson, with his moral courage, was the philosopher who made the most profound impact on our family circle.

In the days of my youth, we had no radio, television or movies. We found our Sunday diversion in the family reading of sermons by two of New England's great nineteenth century preachers, Horace Bushnell and Phillips Brooks. Bushnell was to theology what Copernicus was to astronomy. He changed the old narrow point of view, and broke down the barriers of distrust between differing religious groups. Brooks also exercised unique influence. His example of sympathy with men of other thought served as a strong encouragement to religious tolerance.

Modern science has to considerable extent outmoded the excessively supernatural aspect of the faith of Longfellow, Emerson, Bushnell and Brooks, but

not their humanity, their compassion and their sincere love of their fellow men. How is it then, in this age of scientific enlightenment, in which the educational institutions of New England are playing a conspicuous part, that bigotry, intolerance and fanaticism are the stock in trade of some of New England's most successful politicians? How, for instance, could Connecticut, a state whose universities are the admiration of the world, produce a Senator like Dodd? How could the great Commonwealth of Massachusetts, noted for intellectual leadership, send forth to high national offices men who regard one third of the human race with hatred and bitterness?

Incredible as it now seems, when I was an undergraduate sixty years ago, interest in science was relatively slim, and today's overpowering demand for scientists and engineers was not even vaguely anticipated. At college, my preoccupation was with history, literature and philosophy. I perhaps too readily accepted Milton's advice to "let Euclid rest and Archimedes pause."

Impact on Engineering of Early Industrial Giants

If my thoughts were remote from science, pure and applied, during most of my school days, I can assure you that I have more than made up for the omission in every year of my life since. To begin with, I got the first glimmerings of the dependence of industry on science and technology in the vacation job that I held for several summers with the original John D. Rockefeller.

Here was a man of limited formal education, but unlimited intellect and vision, who created the great oil industry, and founded a fabulous fortune that is still being used for the advancement of learning and other worthy purposes. It was Mr. Rockefeller's advice to get a stake in natural resources that set me off on

the road to basic industry, and to early realization of my need for a knowledge of technology and close collaboration with its trained practicioners.

There were others cast in the same mold as Rockefeller, whom it was my privilege to know: Carnegie of steel, Edison of electricity, Ford of automobiles and Firestone of rubber. None of them got beyond high school, but each goes down in history as a genius in his own field, and each gave a lasting impetus to technology. An interesting -- and overwhelming -- statistic would be the number of trained engineers who have made their careers in industry as a result of the work of these five pioneers.

How One Layman Broadened His Technological Horizons

My entry into business and industry on my own, after college, plunged me into technology with almost a vengeance. I found the need not only of associating myself closely with scientists and engineers, but also of making studies for myself in applied science and related fields. To prepare for the public utility industry, I took an after-hours course in electrical engineering, and used the rest of my spare time to immerse myself in all of the journals and other up-to-the-minute literature concerning the production and distribution of electricity. Such reading has always appealed to me as a greater source of pleasure and profit than the funny pages and comic books -- to the frequent distress of my family and friends, I must admit.

Since we were producing most of our electricity in steam plants, I found it prudent to move on into learning as much as possible about coal, its geology, mining and preparation for use in the boiler to produce steam. At the same time, a course in accounting obviously became desirable for better grasp of finance, and a knowledge of marketing was also essential. Most of this study, as I have already indicated, was accomplished out of working hours.

Without subjecting you to further detailed illustration, let me say that my subsequent affiliation with such other basic fields as steel, iron ore, transportation, paint and chemicals, rubber and agriculture, in addition to public utilities and coal, has similarly broadened my technological horizons. In pursuing these widely ranging interests, I have been fortunate in associations with able experts in many of the specialized areas that are encompassed by your M.I.T. curriculum. I am also proud to have been identified as a trustee for a number of decades with Cleveland's Case Institute of Technology and The University of Chicago, with its extensive scientific and technical faculties.

Engineers as Executives and Public Servants

A number of the ablest business leaders and public servants of my acquaintance have been trained engineers, whose broader interest in public relations and public affairs has led them to make their life work beyond their immediate fields of specialty. An appropriate model of engineer turned industrial executive to cite here would undoubtedly be an old friend of mine, the late Paul Litchfield of Goodyear Tire & Rubber fame. It used to be said of him, almost as much in truth as in jest, that he would never hire anyone but M.I.T. men for Goodyear.

In the field of public service, one of my favorite examples is the late William Stinchcomb, who started as a city engineer in Cleveland and went on to become head of the Cleveland Metropolitan Park Board, on which I had the privilege of serving as a trustee for a decade. Combining his training as a skilled engineer with a keen interest in government, politics and public relations, he succeeded in developing a great park system that provides matchless outdoor recreation facilities in a "Ring of Green" around the half dozen counties surrounding the City

of Cleveland.

I have enjoyed equally valuable relationships with leaders of pure science. These friendships have grown out of a lifelong predilection with philosophy and its relationship to science, as well as an ever growing concern with world affairs, where the most advanced accomplishments of science, pure and applied, now seem destined to play a decisive role in determining the fate of all mankind.

Now, you may be wondering, what has all of this to do with the engineer as philosopher and citizen, the title I have chosen for these remarks? Simply, this. In a sense, I am inviting you to draw upon these experiences that opened up new vistas for me, a layman, to find ways to widen your interests beyond your immediate profession. But there is more to it than that.

The Adventure of Learning

You will emerge from this great institution with an intensive training mainly in applied science. To pursue your chosen calling with maximum success, you must of necessity concentrate your schooling on a somewhat narrow field, and certainly it behooves you to excel in your specialty. The demands of these all too brief college years leave you limited time for study of other subjects. Yet you need to expand your knowledge and understanding in many directions if you are to become a truly great engineer, not to mention a well rounded man.

What I should like to advocate most earnestly, not for engineers alone, but for all men and women in every walk of life, is adult or continuing education. Whether for discipline, practical benefit or sheer recreation, the adventure of learning, and applying what one learns to life, should never end. Pursued regularly, in classes or alone, it has irresistible and enduring attractions for those

lucky enough to acquire the habit and keep it throughout their days.

On this continent, we have extensive educational and library buildings and facilities that ought to be kept in constant use, for continuing as well as undergraduate and secondary education. This is a vital field in which we of the western world cannot afford to let ourselves fall behind. If you have occasion to visit the Soviet Union, you will see what I mean when you go to the great libraries and find them literally crowded with eager adults. The avid desire for learning on the part of citizens of all ages, and in all walks of life, is, in fact, a most striking phenomenon of modern-day Russia. As engineers and scientists, you will also be indelibly impressed with the unlimited scope enjoyed by your Soviet counterparts.

Reading as Recreation

For recreation, as well as education, there is nothing equal to reading, to offset the daily excitement of the life of action led by successful business and professional men. Fresh air and exercise are also indispensable. Some of you will find them in your work, but most of you, like me, will make them a part of your spare time pleasures. Let me add that they are aids to sound sleeping and good digestion, two highly important but often neglected elements of a successful career in any field.

As you go on in life, you will also learn a fuller appreciation of the importance of equanimity, even at times when the whole world seems to shout against you. You must strive for the self control and self reliance to maintain tranquility of mind against family cares and business problems, however serious. The model of this ideal life of reason is Marcus Aurelius, Roman Emperor and Stoic philosopher, whose Reflections are a well thumbed volume in my library.

Four British scientist-philosophers of the 19th century, whose works I should like to commend to you, are Darwin, Huxley, Spencer and Tyndall. Each of these great minds played a part in establishing the scientific viewpoint and in relaxing the superstitious restraints on human progress. Darwin, of course, changed the whole concept of the origin of the universe, the origin of life and man's destiny, with his philosophy of evolution.

Science Versus Superstition

Science and superstition have traditionally been at odds, as you well know. Galileo, father of modern science, was forced to recant the cherished theory proved by his revolutionary telescope, that the earth revolved around the sun, in order to avoid execution at the hands of the Inquisition in the early 17th century. The prosecution of an American school master for teaching the theory of evolution, as recently as forty years ago, by William Jennings Bryan, three times the choice of his party for the Presidency of the United States, indicates that science must still remain on guard against its traditional opponent.

Two writers of the 20th century who are well worth reading for their lucid views on the relationships between science and philosophy are Bertrand Russell and the late George Santayana. I hope you will all some day take occasion to read Russell on "The Scientific Outlook" and Santayana on "Reason in Science."

Lord Russell, as you know from your daily newspapers, is emphatically a man of his own convictions. He has been a friend of mine from the time when he lectured at the University of Chicago some years ago, and more recently we have been collaborators in the Pugwash meetings of scientists. Grandson of a British Prime Minister, he has earned fame in his own right as a mathematician,

scientist and philosopher, a keen student of social questions with a wide ranging mind and a writer with the gift of expressing himself in such flawless prose that he won the Nobel Prize in literature. I admire him for the stubborn fight he is making to drive home the hazards of nuclear warfare, to the point where he has been willing to go to prison at the age of 89.

The engineer, with his basic grounding in science, is a logical candidate for philosophical speculation as an absorbing pastime. Science still has many profound secrets to disclose, and even the most creative thinking of the best minds may remain long at a loss for even approximate answers.

Science and Philosophy

The origin of the vast universe, of our own little planet, of life and of mind are fascinating problems that challenge the imagination. The philosopher Kant postulated that the mind must come from God because it cannot be explained scientifically. Will the scientists ultimately determine that all thoughts are based on physical and chemical rules and reactions, and not on the intervention of the supernatural?

Consider the seed. The scientists can determine its constituents with complete accuracy, but they cannot yet reconstruct it to accomplish its seeming miracle. The seed contains its past, and is endowed with a directing power to determine its own future. Can science solve this riddle?

Take our own small world in relation to the rest of the immense universe. Our powerful telescopes now reveal a billion stars, each comparable in size with our sun and all part of our own Milky Way, which is but one of many million similar galaxies. The light from the farthest star on which we can train

our telescopes, traveling at the speed of more than 10 million miles a minute, has taken some 250 million years to reach us. Now, during a great part of the past existence of our earth, it was too hot to support life and, during a great part of its future existence, it will be too cold. Can it be that, at this moment, there is no life anywhere in the universe except on our little planet?

Commonplace Answers for "Insoluble" Scientific Problems

Many scientific problems that seem insoluble today will undoubtedly find commonplace answers within a relatively few years. Consider the case of Simon Newcomb, astronomer and mathematician whom Einstein credited with the mathematical foundation of his own great calculations, and incidentally the only man of Canadian birth ever elected to the Hall of Fame of Great Americans. Newcomb was willing to stake his reputation on the proposition that man would never achieve heavier than air flight, but would have to remain content with the kite and the balloon.

Interestingly enough, this was known by Major Yuri Gagarin, whom I met and spent some time with in Europe just after his historic first flight into space. Gagarin had attended scientific school, where astronomy was one of his principal subjects, and he was an admirer of Newcomb's work in this field. Later, when Gagarin was my guest in Nova Scotia last August, he was delighted to learn of the historic marker that identifies the place of Newcomb's birth near Pugwash.

The Engineer as Citizen

Now I want to turn to the engineer's obligations as a citizen, quite apart from his professional work. With the world on the brink of self-extinction, the engineer, with his reputation for straight thinking, perhaps has a greater than usual responsibility to take an active part in public affairs. If he does not actually

run for office, he must impress his views on those who represent him in government. While there are many able men in politics, there are also far too many whose sole motivation is to get elected and re-elected in order to be on the public payroll. Formulation of crucial national and international policies at this most critical juncture in history cannot be left to chance.

The increasing impact and tempo of the cold war and the nuclear arms race are making themselves felt throughout the whole fabric of society. The development of the telescope and the microscope early in the 17th century marked the beginning of a slow but steady retreat of superstition. The development of the A-bomb and the H-bomb in the mid-20th century seems to have heralded an unprecedented reversion toward unscientific irrationalism and emotionalism. Madness is sweeping the world, and the nations with the richest resources, that could do the most to advance human welfare, are straining their substance to pile up hideous weapons of warfare which, if ever used, would incinerate the planet.

The Role of the Scientists and Engineers in the Arms Race

One exceedingly distressing aspect of this arms race is the extent of the involvement of the scientists and the engineers, whether they are affiliated with industry, education or government. In the United States, some $50 billion is being poured annually into preparation for war. No one is permitted to know the exact allocation of this fantastic sum, but it has been calculated that hundreds and hundreds of millions are being channeled into the universities and technical schools for defense research, so that even education has a vested interest in armament.

From the Pugwash Scientific Conferences, I have abiding belief in the desire of the scientists to see their great accomplishments turned to construc-

tive purposes. The Pugwash meetings, which it was my privilege to initiate, in response to the Einstein-Russell plea for world-wide consideration of nuclear hazards, have brought together 150 of the world's leading scientists from 25 major nations, east and west. Among my treasured Pugwash friends, by the way, are Sir Charles Darwin and Sir Julian Huxley, gifted grandsons of the original Darwin and Huxley. These men of widely varying creeds and ideologies have succeeded in reaching a large measure of agreement in their deliberations, because they are thoroughly aware of the deadly nature of thermonuclear weapons. Unfortunately, they have not yet found the way to transmit their urgent message to ordinary men, whose combined voices or votes have their effect on the politicians.

If we somehow survive the present crisis, and I fervently hope we will, I believe we will enter upon a new age of reconstruction in religious, scientific, economic and political thought. We have reached a time in history when all of our theories and opinions need to be subjected to the same searching analysis and scrutiny that the scientists and engineers bring to bear on the concrete problems with which they daily deal. Here, I suggest, is the greatest opportunity for those of you who, from your scientific training, are used to dealing with facts rather than myths. Good luck to you in an exciting endeavor.