THE CITIZEN AS AN ENGINEER

by

Wm. T. Meade, M.E., E.D.
Prof. Mech. Engg.,
The Ohio State University,
Columbus, Ohio.
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A few years ago this university was satisfied to have one commencement annually and one formal departure of her graduating class from her campus for the broader walks of the world. If a student completed his work at some other time than in June, the question would occasionally arise as to what class he belonged, and thus arose the phrase, "As of the Class of". Now traffic is heavier and the transportation officers call for sixteen through trains quadrennially from the high school through the university to professional and business life. Not a few, having tasted at the Spring of Knowledge, have stayed longer, drunk deeper, and become better prepared, we trust, to take part in the work of the world for which a university education should most assuredly fit them.

Dr. Stanley Hall used to tell his classes at Johns Hopkins University that a broadly-trained and astute-minded person could tell by the speaker's conversation and use of words what were his vocation and his hobbies. Lest there should be any doubt in your minds as to my vocation, I desire to state at the beginning that my subject for your consideration this afternoon is THE CITIZEN AS AN ENGINEER.

The old classical idea of a citizen was that of a free man who dwelt in a city or town, rather than in the country; one who preferred civic life to rustic life. Athens is said to have had 400,000 slaves to 100,000 free citizens. The industries of Rome were operated almost entirely by slave labor. Nowadays, with the development of agriculture and the improvements and comforts of life which are com-
monly found on the American farm, many people prefer the open life of the country to the more confined life of the city, so that the older definition does not obtain with us today. The fourteenth amendment to the Constitution of the United States says that, "All persons born or naturalized in the United States and subject to the jurisdiction thereof, are citizens of the United States".

When the British Institution of Civil Engineers was founded, engineering was defined as "the science and art of using the forces of nature for the benefit of mankind". This was in distinction from military engineering, the only other kind then known, wherein the forces of nature were used for the destruction of men and property. Thus, early in the later life of the profession, we see the recognition of the engineer as a benefactor to mankind. The engineer has always been the advance guard of civilization and the interpreter of science to the business world. He is essential, not only to economic welfare, but to social advancement.

We are accustomed to bragging about our irrigation works and our great dams, but they are far from being the greatest that the world has ever seen, and would be business failures if they were not governmentally owned. As it is, many of them are monuments to the poor judgment of the statesmen who caused them to be constructed, and to the great skill of the civil and hydraulic engineers who constructed them in a desert. But irrigation projects are not new. The main Babylonian canal is said to have been 200 miles in length, 100 to 400 feet in width and to have varied from ten to forty feet in depth. With its tributaries and its reservoir, forty miles square, it made that country to be the Garden of Western Asia, and, by its agriculture, to support a population that was probably as dense as any that history recounts. The gates of
Babylon were of brass and several of them were opened by machinery. One of the temples of Babylon contained thirty million bricks. At the usual rate of laying bricks today, such a building would require the services of one hundred bricklayers for two years. If it had been a university building, using from one to a dozen bricklayers it would have taken a century or two to have constructed it. And yet, Nebuchadnezzar boasted about having built one of his temples in fifteen days.

Sir William Wilcox tells how the Egyptian engineers created a civilization which lasted for 3,000 years. The steam turbine which was reinvented fifty years ago in America was first invented in Egypt about 200 B.C. Only recently are we beginning to get a fuller conception of what these ancient peoples possessed and enjoyed. Every school boy of Roman history knows something of the Roman aqueducts which supplied the Imperial City with water for its baths and for drinking purposes. The Coliseum at Rome seated 87,000 people and is said to have held 100,000 people, or one-third more persons than does our own Stadium.

When one of the kings of Assyria went to war against the Arabians, he had to transport his army and its supplies a distance of 980 miles, or as far as from New York City to Chicago. Of this distance, 280 miles was through the arid desert, or further than from Cincinnati to Cleveland. This is a larger piece of military engineering than any modern army has ever been called upon to do. Truly there were great engineers in those ancient days, but they were either military or civil engineers.

And now let us consider what the modern engineer has done for civilization. The present is an age of power, and therefore of engineering. Mechanical power is the agency which has set the successor of the ancient slave free from his grinding and laborious toil. Slavery was as great an economic failure in the South as it had been in the North until Eli Whitney, a Massachusetts inventor and engineer who had been
educated at Yale University, went to Georgia and invented the cotton gin. That inventor caused the growing of cotton to become the major agricultural industry of the South, provided work for the slaves, created a demand for their labor in the cotton fields, and so made slavery in the South profitable. Mechanical power caused the industrial revolution in Great Britain 150 years ago and changed home industries into manufacturing industries. Power plays a large part in the life of each of us. We are all of us machine-trained. Even our veneer of culture is applied with the ink-distributing roller of a printing press through the printed pages of books and periodicals, or by a telephone, or through the impressions on our ears of the vibrations of the ether created by a radio machine. With rare exceptions, all the articles of clothing that we wear, the food that we eat, the water that we drink, the air that we breathe when not out of doors, the furniture that we use, the beds on which we sleep have been made or purified by machinery. Home-spun clothes are now seen only in museums or on the stage. Baking at home is a declining art and bread making is a lost art, except in machine bakeries operated by consolidated manufacturing companies. We now get our foods from the neighborhood which have been made, filled, and sealed by machinery, grocery in machine-made, filled, and sealed tin cans or paper boxes and no longer from the crock or hanging shelves in the store-room. The modern pumping-engine has replaced the old, oaken bucket whose sides were soiled with impure water, green scum, bacteria, and wayside dust. The air that we breathe in certain buildings is washed of its dirt and germs, dried, and humidified, and in some places treated with odors of gums and medicines which are thought to have healing and curative properties. The shoes that we wear are probably made on a machine, or on one of its successors, invented by my predecessor, Professor S.W. Robinson. The cereal that some of you ate for breakfast was probably wrapped,
or enpackaged, in a machine designed by one of our alumni. The day has now arrived when the civilized man in this country must be trained to use machinery in the office, in the factory, in the home, on the farm, and on the road. The better he is trained, the simpler and easier will life be for him. Because so few people understand why a gasoline motor-car operates, or, as they would say, "Why it goes", is one reason why there are so many accidents on the road today. The farmer who does not use machinery today is a fit subject for either the poor-house or the bankruptcy court. The woman who has not a motorized kitchen and house is either a woman of wealth and leisure with a multitude of servants or something of a drudge. All citizens should know something of engineering, either by training or education, or both.

When it comes to the manifold uses of that greatest servant of all, namely, the electric current, time forbids me to do more than to mention the subject. For, as a means of transmitting energy which can be changed into so many other forms of mechanical power, light, sound, heat, and their numerous modifications and applications, we are in very deed living in an electric age. It should be remembered, however, that the electric current is generated today economically only by the generation and expenditure of mechanical power derived from the potential energies of steam, gas, oil, or water. In 1924, the output of electricity in this country was almost sixty billion kilowatt-hours, which means a revenue of from three to five billions of dollars. The saturation point is still far ahead. In 1902, the annual output of electricity in the United States was 32 kilowatt-hours for each inhabitant. In 1912, it was 122 kw. hr. In 1924, it was 485 kw. hr. for each inhabitant of this entire country. While there are today, thirteen million users of electric current in this country, there are still nine-million residences which have yet to be wired. In Ohio, there are 1,074,908 customers using
eleotriaity, or one electric current customer for each six inhabitants.

Electricity has not only connected the farmer to the city, but it has wired the farms together. Eighty-six percent of the farmers of Iowa, and probably fifty percent of the farmers of this state have telephones. When deep snow prevents the farmer from going to town, it does not prevent him from having a talk with the world, or from listening-in on conversations on party lines, or from hearing speeches, music, or crop reports sent out by radio. On October 31st, there were a total of 1,013,775 telephones in use in Ohio, or one telephone to each six inhabitants.

President Walter S. Gifford of the American Telephone and Telegraph Company says that "the telephone business is the largest retail business in the United States as it handles sixty-four million transactions every twenty-four hours, or four messages per telephone." There are few citizens in this country today who have to ask how to operate a telephone, as once was the case and is still the case in most foreign countries. Thanks to the telephone companies' desire to secure the cooperation of all users, some of us have some idea of what happens when a telephone number is dialled.

Only two percent of the steam railroad mileage of the country has yet been electrified. It is interesting to watch the commercial duel now being fought between the largest two manufacturers of electrical machinery and to remember that one or more of the leaders in the electrification of steam railroad of each of these companies is an electrical-engineering graduate of this university.

The human animal develops one eighth of a horsepower for short periods of time and one twentieth of a horsepower at steady work. As a craftsmen who uses his brains to direct his skill, he may earn his pay. Wherever a machine can be continuously used, the use of a man's muscular power is uneconomical, except for irregular and intermittent work and for
short periods. This statement is still more true for the muscular labor of women. In one of its booklets (G.E.K.-1) the General Electric Company shows the many ways in which electricity can be used as power, and states that "one man with a fifty-horsepower motor can do the work of four-hundred laborers, and is paid far more for his brains than his brawn". It draws the conclusion that "the great need of this and future generations is for men who can plan and direct" the use, construction, and operation of motorized machinery.

Because of the almost universal use of machinery, it is necessary that

only that men and women should be made to understand why a machine operates, but how it operates, how it can be put out of order, what are the things to look for when it fails to start or perform properly, and how to remedy the trouble. To use the vernacular, we should all be trained to be "trouble-shooters" of the machinery that we have bought and purpose using.

All citizens should be trained to use machinery from a typewriter and adding machine to a motor-car, and from a can-opening machine to a vacuum-cleaner. The more the operation of machinery is understood by men and women, the more will be the demand for better machines and men to invent, design, and construct them. None of you who will receive your engineering degree today need fear for your position, as the chances are that you will be expected to work overtime in order to invent, design, and construct better machines than those made by your company's competitors.

Transportation is today, as heretofore, a matter entirely of power, but no longer one solely of animal power. Saddle-bags are now seldom seen except in isolated and rural communities. If the constant use of motor-shafts by the occupants of office buildings continues, the leg muscles of these men and women will go the way of the saddle bags, as they will have no use for them only from their residence to their garage, from the parking space to the elevator, and from the elevator to their office chair,
and back again. Are not many of us losing our powers of locomotion? Is not one of the blessings of golf that it tempts office people and other sedentary workers in shops and factories not only into the open, but to use their legs occasionally? In 1924, the State of Ohio licensed 1,050,041 passenger cars and 153,889 trucks, or a total of 1,203,930 motor vehicles, or one machine for each five inhabitants of the state. As the ratio of cars to people in Ohio is increasing, it would be quite conceivable for every man, woman, and child in Ohio to be motoring at the same time in some form of an automobile. We could all be traveling on rubber, and be off the ground, even if not very far up in the air. The best part of such a universal joy-ride would be that there would be no pedestrians to get into our way. The saddest part about it all would be that several thousand cars would be running into other cars, telephone poles, and ditches with the result that possibly one thousand people would be killed and several times as many would be more or less permanently injured.

Comparing the power statistics collected by the Bureau of the Census in 1869 with those collected by it in 1919, we note that in those fifty years the sources of power have changed from water and from steam derived solely from coal to power derived from water, coal, oil and gas. Then, there was 6,827,000 horsepower available for the 38,556,371 people. In 1919, over five-hundred-million horsepower was available for a population of 106 million people, or not quite five horsepower for each inhabitant. As a man’s power for steady work is only about one-twentieth of a horsepower, this means that the labor of one hundred able-bodied male slaves was available for every man, woman, and child in this country in 1919, provided that the slaves and their families did not have to be fed, clothed, and housed. In 1869, there were no gas and oil engines. The seventeen millions of motor-cars, trucks and tractors which are now in use in this country and capable of developing a total of 340-million
horsepower did not then exist. In 1869, only animal power was used on the farm, and amounted to less than ten-million horsepower. In the past fifty years, the use of animal power has doubled on the farm, but the use of mechanical power has increased to twenty-million horsepower.

From the above statements and statistics you will all see the great use that is made of power in this country, and the desirability of every one having some knowledge concerning its operation.

Considering the increasing use of power for human needs and the corresponding demands for its generation and efficient use, it is evident that there must be a large demand for the labors of the brains and bodies of trained men. These men may come from the colleges or along the slower and more laborious routes through practical work and the training received in the industries. The National Industrial Conference Board finds fault with the engineering colleges because they are graduating annually only ten-thousand men, while the demands of the industries are for over forty-thousand trained workers each year.

Reports for the last three years show that an average of sixty-two organizations have applied directly to the Department of Mechanical Engineering, asking for the services of 135 men from each of the graduating classes of this university, and that these classes have averaged only 47 men. These facts show that there were almost three positions available for every graduate. In our other engineering departments, the demand for graduates far exceeds the supply, and it is not at all unusual for a very promising man to have five opportunities for work. There are few, if any, alumni available. The Department of Civil Engineering has had 27 calls for men since October last. Some men will consent to be moved into better positions having more outlook for advancement, in pleasanter localities, with better opportunities to make up a family in happiness, and at larger salaries. The engineer seems to be a contented citizen.

From this it will be seen that the demands for the engineering graduates are far in excess of the supply, and that those who make the demands
must content themselves with men trained either in practice or in some other branch of learning. Here again is the chance for the citizen to cooperate with the engineer for the advancement of civilization, health and happiness, and good business. As Horace Greeley once said, "There is plenty of room at the top." But it should not be forgotten that there are plenty of rungs in the ladder at quite a distance below the top, and which are neither crowded with climbers nor uncomfortable. Either the observations and experiences of the engineering colleges are in error, or there is a fallacy in the oft-repeated statement that the colleges are turning out too many men. Industry needs and is asking each year for an increasing number of men of proper training, good judgment for their ages, and with a little of that uncommon thing called "common sense".

But some will say that the college graduate is content to receive a small wage, that it is a long way from the door of the college to his own office door, and that only a few of them reach comfortable affluence. The reply is not difficult. My observations going over many years is that about every twenty years some one collects and publishes his findings as to the salaries of different kinds of professional men. (Net wages, as we are concerned with professional men and not with artisans and mechanics, with all due respect to them, our needs for their services, and their abilities.) Some forty years ago, data collected in New York City showed that the average income of the professional engineers, living and doing business there, was slightly greater than the incomes of the lawyers and physicians of that city, - both one year after graduation and at forty years of age. Of course, there were many exceptions among the lists of brilliant lawyers, skilled physicians and surgeons, and capable engineers. Some twenty years ago, Mr. James M. Dodge, a leading business man and engineer of Philadelphia, showed conclusively that a man with a technical
education would average much more income during his life than would the man who had not received such an education as the world and the industries needed; in other words, that a college or technical school education had a market value, if it preceded from a mind and head that could use it. More recently, or in 1924 to be exact, Dean Everett W. Lord of the College of Business Administration of Boston University, basing his figures on the reports of the Massachusetts Department of Labor and Industry, and on statistics of the earnings of students and graduates of the College of Business Administration of Boston University, found that, while the college or technical school graduate may earn a considerable amount of money while he is in college, his permanent earnings do not begin until he is twenty-two. With us here, it would be over twenty-three. At twenty-eight, his income is equal to that of the man at forty with only a high school education; and that instead of stopping there, for the remainder of his life, his income continues to rise, practically without a break, as his income is dependent upon his mental ability and training which are constantly improved by practice. Dean Lord’s statement, that the average income of $6000 at sixty years of age for the college-trained graduate is often surpassed, is most modest and conservative. He states that, while the total earnings of a high-school graduate between the ages of eighteen and sixty will be about $78,000, the total earnings of the college or technical school graduate between the ages of twenty-two and sixty, and not including anything earned during his college period, will be $150,000. He concludes that the $72,000 more earned by the college graduate than by the high-school graduate represents the cash value of a college or technical training. While Dean Lord claims that the figures that he has collected may not be "authoritative", he considers them to be "reasonably accurate". As they agree with those of other investigators in this field, there seems to be little reason for doubting his conclusions. You men and women are therefore to be
congratulated that you have started to acquire a competence that will permit you to use your talents and education in ways best suited to your opportunities and to your desires and in accordance with your highest duty.

A committee of our Engineering Faculty has been for over a year cooperating in an investigation of engineering education that is now being made under a grant of $108,000 made by the Carnegie Corporation to the Society for the Promotion of Engineering Education. Judging by the confidential figures that have been received from our engineering alumni, very interesting averages of salaries of the alumni of certain classes might be offered in evidence. Suffice it to say that, without going into details, Dean Lord's figures would seem to be very conservative by comparison with those sent in by our own engineering alumni.

If, as I think has been shown, the demand for graduates of our engineering colleges is several times the supply, and the incomes that may be earned are equal, if not in excess of those earned by other professional and business men, why, it may be asked, is there not a flocking to such a vocation and profession? The answer is not easy to give, as there are almost as many answers as there are cases. In my opinion, the chief answer to this question is that there are an engineering type of mind, a distinctively engineering line of attack on a given problem or question, and engineering method of thought, and plan of procedure. These are not easy to acquire. Very few engineers ever fail in business, and then usually because they have been beguiled and allowed their friendships to get the better of their judgments. The engineer first asks what are the facts. He goes more slowly but gets there sooner because he does not have to retrace his steps. Opinions may come later when facts are found to be not obtainable. Opinions are what one thinks rather than what one knows to be true. They are based on evidence which does not produce certainty of knowledge. The engineer, while not necessarily a disbeliever, wants
to weigh the evidence, compares it with what he already knows, consults authorities, does some experimental work to find what the facts really are, takes little for granted, gets down to the bottom of the matter, and follows St. Paul's recommendation to "Prove all things". (1 Thess. V; 21). These things mean intelligence, mathematical attack, all the permutations considered, accuracy of thought and action, and care used in recording and in interpreting the results. They involve a slow and laborious process. It does not mean jumping to conclusions. It may mean, and not infrequently does mean, that the time consumed in the slow process is not warranted by the results to be obtained. Herein is where an engineer must use his judgment and good sense, and decide in advance that the expenditure of time is justifiable, for the engineer should be both a scientist and a business man.

The question is now being frequently asked, why do not the colleges get the kinds of boys that the industries and the professions demand shall be educated to become engineers for their employ, or members of one of these professions. Why is it that of three students who enter college, only one succeeds in finishing and in getting his degree? Here again, the answer is not easy to give. It is probably due to the same causes which decide that of every one hundred children who enter the grammar grades of our schools, only five will ever enter college and only two will ever be graduated. Why do not the schools send us more capable students? The reply is that they are not available. A distinctly different type of mind is required in the making of an engineer, than that required in the making of a lawyer, a poet, or an artist. Possibly, if we had more skilled teachers in our public schools and in our colleges, and if better and more practiced engineers were teaching in our engineering colleges, the results would be better. But, here again, it is a question of supply and demand. If the public could be made to believe that there were no
short cuts to universal knowledge, and that the average passing grade in school and college will not be tolerated in business or professional life, it would be better for the children. The parents would probably try to induce their children to get down to hard work and intensive study rather than to work hard to see with how little work they could make a passing grade. It may be true that the average passing grade in some high schools is very low. Judging by the results and considerable experience, I am confident that such is the case. It is not that too many high school boys and girls are going to college, but that too many of them have not the proper attitude and have not had the serious and intensive training which fits them for college and which the business world demands. This is the reason that some employers prefer not to take college and high-school graduates until two years after graduation or until after someone else has broken them in to intensive work, and they have found themselves, and decided to get into the game of earning a living. Until parents and their children learn to take more seriously the work of becoming educated, and trained, and prepared for happy and useful lives, the demand for well-trained children by the colleges, and for young men by the industries and the professions is bound to exceed the supply.

The engineering qualities which I desire to call to your attention as citizens are not impossible of attainment. They are well known and possessed to some extent by every one. They may be called the seven mathematical virtues and are worthy of cultivation. First, there is the basic honesty virtue of honesty; mental with yourself in your thoughts and conceptions, and then moral with your friend, associate, competitor, community, and nation. Second, the virtue of accuracy, when applied to a reasonable extent. Third, thoroughness and completeness in all necessary details. Fourth, clearness of thought, idea, statement, and intention. Fifth, promptness in keeping engagements and appointments, in paying one's
ordinary obligations and debts, and in doing the thing that is to be naturally and properly expected of you. Sixth, patience with the faults and acts of your associates or employees. Seventh, obedience to moral, civil, physical and other natural laws. These are all qualities concerning which it is rather easy to judge. A man is honest, accurate, thorough, clear, prompt, patient, obedient, or he is not. There is little chance for compromise. They are the lesser virtues which do not replace, but rather supplement, the seven major or principal virtues. I urge your consideration of these homely virtues at your leisure. They offer plenty of food for thought.

I have no means of knowing what caused any one of you to come to college, least of all to this university, or to follow the curriculum which you have now completed. It may have been the old one of the family fetish that "all the men of our family have been educated at this university", although this reason is not likely to apply to you and your family and to this university because of its youth. It may have been because it seems to be the modern fad to go to college, because one's chum is going, or to make friends, to get up in the world, to find a husband or wife, or because it is the "right thing to do for people in our class". Or it may have been determined from the strictly selfish point of view, because you had heard that, when you were graduated, several companies would be wanting your services, and that some appointment committee, or head of a department, would see to it that you obtained a position at pretty good pay. But I hope that the large majority, if not all of you, were guided not by such precedents or reasons, but rather by your ideals of what the object of a suitable education for you should be and by the desire to develop your talents, to cultivate your minds, to prepare yourselves to have the greatest amount of health and happiness in life, and to be of the greatest possible service to your fellow citizens, all
of whom have been contributing indirectly for your education during these last four or more years. You should remember that you have been the recipient of the advantages and the pleasures which you have derived from the use of this campus, its buildings, and its equipments. These have cost the people of the State of Ohio and others the sum of thirteen and a half millions of dollars and their present value is very much greater. The interest on this investment at six percent is $74.00 per student per year. You should not forget that the State of Ohio took from its general revenue fund and spent last year almost five-million dollars for the education and capital investment for the benefit of the 11,535 students that it permitted to be enrolled in its State University. This means an expenditure by the State of Ohio for each of you for your education and benefit of the sum of $430.00 per annum, which, with the $74.00 interest on the investment, makes a grand total of $504.00. For the four years of your residence here, it means the expenditure by this state and nation of almost two thousand dollars for you alone, or the use of the interest on something like $7500.00 during each year that you have been a university student. Now my object in calling these facts to your attention on this your Commencement Day is not to make you feel unhappy, but rather the opposite, to call your attention to your many blessings, to congratulate you that it is your good fortune to be a citizen of this country, to have been born in Ohio, or to have come here to live, and to cause you to see and appreciate the fact that wise leaders in legislature, Board of Trustees, and faculty have striven earnestly for many years to make those dollars produce largely, to be spent wisely, and to be as effective as possible in giving you the education which is the heritage of every American citizen.

But it should not be forgotten that with every blessing comes a
duty to make that blessing reflect itself in the lives of others;
that, having received much and proven yourselves to be among the upper
three or four percent of the people of the state in intelligence, it
is now your duty to show your training and leadership by using your
education in advancing the interests of your fellow man in the State
of Ohio, of being loyal to your State and its government, unwilling
to listen to calumny poured out upon it and its officers and citizens
by thoughtless, ignorant, or malicious people, and of being willing
to sacrifice your comfort, your possessions, your family, and even
life itself in the cause of good government, safety, and peace in
the Nation and Commonwealth. "Freely ye have received, freely give".

To this end, I desire to suggest that as citizens you strive to
emulate the ideals laid down by the modern definition of engineering,
namely that it "is the science, art, and business of economically
utilizing the forces and materials of nature and the abilities of men
to promote the welfare and prosperity of mankind". Each of you as
citizens will be called upon many times to do the work of an engineer,
whether your vocation and duty shall lead you to the pulpit, the hos­
pital, the courthouse, the laboratory, the factory, the bank, the
classroom, the store, the shop, the farm, or the home. You will find
that human beings will be the hardest material with which you will have
to work and the most difficult tool that you will have to use. They
will persist in repeatedly getting into your way, consuming your time
and energy to their own disadvantage. Here you must use the virtue
of patience. You will find that the most difficult force that you
will have to overcome is that of friction which is defined as the
resistance offered to the relative motion of two bodies, and there­
fore to lack of harmony. The chief business of many engineers has
always been to reduce friction, and thereby get greater efficiency
between the parts of their machines, between their clients and the contractors, and between the representatives of capital and of labor. The good offices of all reputable citizens are equally needed in this work. To foment trouble, to set one class of people against some other class, to play upon the prejudices of others, to make life harder for the average man to live happily is neither good engineering nor good citizenship. The world needs the services of more engineers of various kinds for various purposes. It can get them only from the citizens of our country. The ends to be obtained by all good engineering are adequate strength, economical design, the minimum cost for the value received, efficiency of operation, and successful business. But are not these the goals which most people seek to gain in their distinctive fields of human endeavor? Engineers are both theoretical and practical, idealistic and common-place. But so are most professional men. For these reasons they need, and should have, the cooperation of all classes of educated men, and the support of all good citizens. Vice versa, you as educated men and women would profit in many ways by striving to follow some of the homely virtues of the engineer, by emulating the practice of reducing the friction between opposing physical, human, and governmental bodies, by seeing to it that things are made right, that machines work smoothly, and that people have a chance to live happily.

It would be well for all the governments of the world to learn how better to use not only citizens who are engineers by profession, education, and training, but also citizens who are engineers by assimilation, in both public life and as governmental employees. When governments shall have learned to use such citizens not only in the Departments of Commerce, as in the case of Mr. Herbert Hoover, with the corresponding decrease of friction and waste in industry, but also in the Departments
of State, War, and Navy, then we may expect to see wars to cease, for the friction which now exists between nations and peoples will have been reduced and engineering methods, and principles, and ideals will have utilized the warlike forces of the world for the "Welfare and prosperity of mankind." Then shall Isaiah's Hebrew prophecy of the coming of Christ's Kingdom come to pass:— "They shall beat their swords into plowshares, and their spears into pruning hooks; nation shall not lift up sword against nation, neither shall they learn war any more." Is. 2:4.