

Evolution of Society as Influenced by the Engineer

The influences of the engineer on society in general are outlined in the following address, which Doctor Merriam presented before a recent meeting of the A.I.E.E. In addition to pointing out the debt of society to the engineer, Doctor Merriam indicates methods whereby the engineer might be of still greater use in the development of a well-informed and intelligent society.

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IT MUST BE with humility that one concerned with general science undertakes to address a group of acknowledged experts in a field of technical study and operation. Therefore, avoiding the technical phases of the problem, this statement concerns itself with the relation of engineering on the one hand to science, and on the other to human problems illustrated in organization and evolution of society.

It is the purpose of this address to refer specifically to the manner in which engineering opens the road to that kind of a social organization of which we dream, and in which we pride ourselves, whether or not we are correct, on the assumption that our present form of social-governmental organization is a success.

What is said here is predicated upon the idea that there is possible a development of the individual to higher and higher levels of effectiveness and enjoyment or usefulness, in whatever way you may wish to define this situation. These statements also are predicated upon the assumption that society in the broad sense is on a road of development leading to more effective means of organization that in time will produce a better environment in which to enjoy and to accomplish.

As to the relation of science to engineering, the statement can be made that science, which may lay large claim to use of the words creative and constructive, is in general not a creative activity. The scientist is commonly discoverer and philosopher. He may develop, he may reorganize, but in the main he is a discoverer of things which already exist.

On the other hand, the engineer, who is thought of as turning things over and using the results from the

work of science, may become a creator and produce that which has not previously existed.

Science is indebted to engineering in that while science may give to the engineering group much that is used for development, the furtherance of science itself is dependent upon what is often referred to as the financial status. One of Huxley's significant remarks was that ultimately everything resolves itself into terms of finance. The scientist does not commonly finance his own investigations.

In looking over the story of mankind one may incline to the view that science, in the natural history sense, was the first form of organized knowledge. There was a classification of snakes that should not be allowed to bite, and of plants that should not be eaten and of those that are good for food. Early in the Paleolithic Period there probably was an organization of knowledge not so very different from that existing today for these materials.

Then came a time in which the problem shifted from keeping out of the range of saber-tooth tigers and snakes, and men occupied themselves more largely with questions concerning how people could get along together. Social organization with government then became the greatest question. Government was perhaps the most important task. It is not yet a complete success, and yet it may be the largest single accomplishment of mankind up to the present day. It is a difficult work but, as badly off as we may be, it is a long way that we have come.

This organization of mankind in government has made possible development of your great engineering programs. Without it engineering could have gone only a short distance. Engineering in turn has placed its resources at the disposal of many kinds of activities, among them the interests of the scientist. Science is now attempting to return to engineering what it receives from this support, made possible in turn by social organization or government in the broader sense.

It is not intended to suggest that science is unimportant. Science is not only significant, but alluring. Adventuring in the field of research is, at the moment, the greatest opportunity that the universe offers. Any one who wishes to penetrate the veils covering the spiral nebulae, or desires to see inside of the sun or the other side of the moon or the various aspects of theories concerning the expanding universe, has an interesting task.

From one point of view the engineer turns the blocks that the investigator discovers into things that are useful in life, in maintaining life, or extending its enjoyment. From the point of view of a scientist the engineers may come nearer than any other group to being what was just referred to as a creator, in that they can produce things which the universe has never known, and continue to form useful combinations and recombinations.

Not everything done through engineering has its immediate human value in uplift. With all the tremendous contribution made by the radio, the music is not sweeter or better, nor is the enjoyment of music greater than it was before that wonderful invention came into use. Many are being trained to music, but is the training comparable to

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that received when we tried to construct music or to use it for ourselves?

Also, when we drive through the country in high speed automobiles it is not certain whether we see more, or less, than in the days when we walked. But this statement must not be left with the suggestion that these contributions do not add greatly to enjoyment of living, and to the profit and to the advancement of the individual and of society.

As to society itself and its needs, no attempt is made here to discuss the great social questions at the present moment. It is worth noting, however, that society has passed through many evolutionary stages, and that at the present moment it is probably faced with greater and more difficult problems than at any previous stages in world history. This is due partly to the fact that the world's interests have been tied together by means that developed out of the operations of the engineer. If the world were to go to crash because this situation has developed, would the engineer be in any sense responsible for the difficulties? If, on the other hand, out of these complications there should arise a situation better than any we have faced in the past, would the engineer be said to have assisted in lifting us to a higher level of development in social organization?

It is not planned to catalogue specifically the difficulties in these great social questions. There is, however, reason for stating that present situations are in large measure due to 3 negative principles, which are: ignorance, bad judgment, and selfishness. The more discussion there is on world problems the clearer it is that the element which is lacking first of all is knowledge of the facts. Judgment is merely the laying out of facts to determine the direction in which they point. The greater the number of facts, the more difficult it is for the average person to form a judgment as to what the situation really means.

When you add the element of self-interest, it becomes extremely difficult with lack of facts, and inadequacy of judgment, to develop a situation in which the great problems of our own country or of the world can be solved. One may refer either to economic questions or to those that concern government.

And now, returning to science, apparently one of the things which the world needs most at the present time is an attitude toward these situations representing a combination of the point of view of the scientist who needs facts, and the engineer who indicates that these facts must have an orderly arrangement with reference to each question considered. If every citizen of this country could approach each of the great questions which we face at the ballot box or elsewhere, with an attitude of mind requiring facts and their orderly arrangement, it would aid greatly in solving our major problems for the immediate future.

As to the question of adjustments in society: at the moment the world apparently has reached a stage in which out of the various needs in life those which have to do with what we sometimes call maintenance, that is, the securing of food and shelter and clothing and such requirements, can be met without use of all the labor in the world. We have produced means of

communication, by train, auto, telegraph, telephone, which make it possible for us to keep in touch over the world. But, with all these means of finding where work is and how to reach it, there are millions upon millions of people who have nothing to do.

The central point to be made is this: We have, whether correctly or not, set up a program of organized society with the assumption that the people will have something to say about their government. No one knows what the result will be. It may be that a people governed by a dictator or a monarch, or by a manager, are in a more satisfactory situation than the one we now occupy. But it is probable that through future generations the people will wish to have something to say about handling the organization which controls them. There can be no doubt that for conduct of such a government we shall require a high level of education, understanding of great national questions, and extraordinarily clear human judgment. Is it possible that shortening of hours of labor is the thing which will open the way for development of an educational program by which the average citizen can form fully adequate judgments regarding the person to be elected as ruler, or concerning questions upon which we wish to express opinion?

Can it be that the situation we meet in the world today is in a manner what is needed to make possible the kind of a government we would like to have? It is doubtful whether democracy can succeed fully without a level of understanding of such problems higher than has yet been attained in any country trying out this system. If so, we must proceed to that kind of an adjustment in which the opportunity offered may be used in some part to make self-government possible.

Perhaps we are coming to the point where we can make the adjustment. Those who are now out of employment may not be the ones to take over the new tasks for education or for improvement. But possibly they can be cared for in the reorganization.

We must continue intensive study of how there can be concentrated in life of the youth the things essential for his beginning education. The young person might spend less time upon this concentrated effort to amass a heap of information before taking up the life he is to lead. Instead of considering his graduation the terminus of education it should be near the beginning. In continuing education of the adult we do not care especially to assimilate masses of facts, but wish to know clear realities in their normal setting. Such a development may be expected in the education of the individual that he will grow in every week of life.

This is then a problem for the scientist, for the educator, for the student of social sciences, and it is especially a problem for the student of government. With all the scientist does to prepare the way for the great things of the engineer he is not in a position to realize in everyday life the whole result of his work. The engineer has a unique opportunity, not just to control, but to build and to guide in the direction under discussion.

Unity of knowledge, diversification, and specialization are important factors. There must be

students of atomic physics, there must be paleontologists, and there must be students of astronomy, but they all represent parts of one great field of knowledge. There must be those who write poetry, and those who preach, and those who teach us the rudiments of art, in order that we attain the most from life as we live it.

We have specialized so far in science that we forget sometimes the relation between work of the biologist studying chromosomes, and that of the physicist working with structure of the atom. We are now beginning to find that great advances in science may come through keeping these types of endeavor so related that the thing needed may be found when required.

The engineer can aid greatly by keeping watch over the scientist, perhaps to see that he keeps on with his task, perhaps to make sure that he receives help when needed. The engineer has a great responsibility in the study of the social problem as related to government. Perhaps he has also a responsibility as a preacher of good doctrine. Whatever has to do with clear thinking and good ideals, may not be separated from life as lived. Possibly we need good preachers among the engineers and good engineers and scientists among the preachers.

A responsibility rests upon the scientist to have some understanding of what the influence of his contribution is upon civilization, upon society. A similar moral responsibility rests upon the engineer to see in what direction his developments are leading us, and the way to formulate such social organization as will make the world we are now building safe for the people in it.

Although we are not headed for destruction, it would be very surprising if progress developed at an absolutely even rate. Sometimes a deviation from what appears the normal path is the element needed to make us inquire what the direction really is.

In conclusion, the contribution of the engineer may be said to be something which paves the way for a social condition or situation opening larger opportunity for the kind of a life we really wish to live.

Perhaps we have tended too much to consider alone the things called comforts, whereas we know perfectly well that it is the pleasures of the mind that are greatest and highest and most important to us. This is true whatever our station in life, or the profession in which we engage. It has not been intended here to turn attention wholly toward pleasures of the mind, or intellect, or toward art or religion. However, it must be emphasized that these should not be subordinated in any social scheme which we may build.

The influence of the engineer has been all for the good in its guidance toward straight and orderly thinking, and toward artistic expression. When a program is planned according to an engineering scheme, the parts all fit, and something in it is the central element. That is approximately the basis of art, which is, in general, the statement of things in a manner that will attain perfect clearness as to the special point concerned, and also the relation of that element to all others in the picture.

This does not mean that forthwith all engineers should become artists, or students of social science or of government. Evolution of society is important, and with all that the engineer does to make life comfortable, it may sometime be said that the outstanding contribution of engineers has been in the direction of making possible the social organization that we are striving to realize.

The Atoms as a Source of Light

"Cold" light, the theoretically ideal conversion of electrical energy into light, is still some distance from attainment, being rendered unattainable largely because of a lack of complete theories of the production of light. A summary of the present knowledge in this field and an indication of future possibilities and lines of attack are presented in this article.

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IT IS NOT surprising that from the very earliest times man has sought to understand the nature of the rainbow. The beautiful harmony of colors arranged in concentric half rings constitutes a marvel upon which many a fable has been founded. It is, however, only within the past 250 years that science has really been able to interpret this phenomenon, and as a result our whole conception of the nature of matter and energy has been profoundly modified.

The array of colors observed in the rainbow is known as a spectrum, and in the laboratory such a spectrum may be produced by passing a fine pencil of sunlight through a beveled glass prism. It is observed that the beam is thereby not only deflected from its original path, but also spread out into a band which shows all the colors of the rainbow.

The glass prism is the simplest form of spectroscope, an instrument by which the light from any source may be analyzed into its constituent colors. While sunlight and the light from an incandescent filament lamp give a continuous spectrum, that is,

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