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THE ENGINEER AND HIS RELATION TO GOVERNMENT[1]

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REAL attention is being given to the professional advancement and the technical interests of the profession. We have an enormously complex system of organization of scientists and engineers in this country, and yet no effective single central organization representing *all* engineers and expressing their viewpoint on public questions. We have an elaborate mechanism for bringing advice to bear on scientific and engineering problems as they arise in government, and this mechanism is not utilized to the full.

What is to be done about it? Certainly no solution lies in forming one more society to join the throng. Integration is indicated; and since societies now exist for all the express purposes we have considered, a duplication of effort by a newcomer would simply complicate matters. Rather, the existing mechanism should be simplified and strengthened.

Would it be of aid if the great national organizations, such as the American Institute of Electrical Engineers, were to take official and definite positions on public questions involving engineering? I do not think this is their proper function, for reasons I will discuss. This is being done in some such organizations, and the effect so far has not been especially helpful. It is another thing entirely for the American Institute of Electrical Engineers to provide a forum for the frank discussion of important questions by men of all shades of opinion. In this I believe it has a duty to perform. So far it has not been done, and

[1] Concluding part of an address delivered at an evening session of the American Institute of Electrical Engineers, summer convention, Milwaukee, Wis., June 22, 1937.

the reason seems to be that those in control have not had the courage to take a step which they fear would split the society. Perhaps a frank and fearless discussion on the floor of an American Institute of Electrical Engineers convention of such a problem as that of the proper sphere of activity of government in the generation and distribution of electric power would split the society. I do not think it would. This is certainly a matter of present interest to electrical engineers. If those who are best able to approach it dispassionately and intelligently fear to open the question at all, how is public opinion to be influenced? In the membership of the institute are men who hold all sorts of opinions on this subject, many of them violently. Many will not express their honest opinions because of their affiliations with government or with public utilities. But there are many more who can and will bring light upon the subject, and, like all subjects of great controversy, it has at least two sides. When I speak of a free forum in this connection I do not mean one where the floor is open to the public. I have in mind one where the participants are carefully chosen for their ability to present their views clearly and calmly, and carefully chosen to bring out all shades of opinion. Such an airing of views on this and many other matters would do a great deal of good. A similar benefit will result when professional publications carry powerful expositions and arguments on the live issues of the day, again with an opportunity for accomplished representatives of all sides to be heard. But the institute itself should express no opinion on this or any other controversial question where its membership holds diverse views. It can not at once be the guardian of a free forum and an advocate. Still it should certainly not be an ostrich.

This taking of stands should be left to a body having that as its primary function. That body should be made up of men of great distinction in the profession, chosen for the purpose by the membership of the profession directly. It should use every legitimate means to be well known to the membership, by questionnaires, publications and by reasonable publicity in regard to its deliberations and findings. It should be absolutely without fear and without prejudice. Its pronouncements should be front page news in every corner of the land. It should enter into any public question involving engineering as a right and without invitation. It should not hesitate to swing public opinion by rousing the profession when such action is indicated. In order that it may speak with a single voice it should represent engineers only, of course with deference to the opinions of other professional groups. We do not have this situation to-day. The metamorphosis of existing organizations, under the guidance of public-spirited engineers, may bring it to pass. As it proceeds it should have the aggressive support of every engineer who has the good of his country at heart, whether or not he agrees with its findings in every respect.

The technique of applying the pressure of engineering opinion on great public questions is only one aspect of our problem. Another aspect involves the advice by engineers to government on specific technical problems. This is a large question and one that involves many of us in one way or another, as citizens and taxpayers as well as engineers.

Government Needs Independent Consulting Engineers

That there is an elaborate mechanism by which government departments may secure the advice of scientists and engineers has been shown. For several reasons, this is not sufficient for the purpose. First, the way is indirect, through an organization that is preponderantly scientific. With the best intentions in the world such an organization can not function precisely and promptly to bring to bear on a great national engineering problem the best engineering brains to be had anywhere; only a few of the great engineers of the country are directly affiliated with it; and the indirect path is cumbersome. The complexities and inertia of this situation were overcome in time of war and in time of great depression, but during normal times the mechanism works feebly. Second, to wait to be called upon in a busy world is not enough, and the present organization has a natural and proper hesitancy to press itself into controversial matters. Third, the setting up of distinguished boards of review on a voluntary basis is not enough.

One can not give sound advice on important engineering matters without spending considerable time and money. This is the function of the independent consulting engineer. We will not be on sound ground in this country until government, on a basis of adequate and dignified fees, calls for the opinions of independent consulting engineers whenever it has an important engineering problem. This it does not do at the present time to any determining extent. If, when the subject has been deeply studied and reports have been presented, the government wishes review by distinguished boards, it always will find men ready to give their services as a matter of public duty. The main reliance, however, must be upon independent consulting engineers, and I wish to make a plea on their behalf.

There are many engineers—many able engineers—in government itself, and these are utilized by government when it has an engineering project to carry out. Army engineers have carried forward on a high plane many outstanding engineering works. The Reclamation Service conducts a research laboratory that is second to none. But the government engineer is not

an independent engineer, and the latter is sorely needed. Given a definite project the government engineer can carry it forward; but he can not at the same time say that it is a foolish thing to carry out at all, even if his engineering studies convince him that it is. Here is a point at which a democracy is at an advantage compared with an absolute government. The dictator has *only* government engineers—units in a rigid machine. Independence of thought and speech there can not be tolerated. Yet, having the advantage as a democracy of the presence of engineers of real independence, we do not make use of them. This is partly because truly independent engineers are becoming rare; partly because unfortunately government is sometimes not anxious that the full truth be known; partly the fault of the engineers themselves. This matter is worth discussing briefly, for it is truly unfortunate if one of the great assets of a democracy is being thrown away.

The rise of great industries in this country, with their own engineering organizations, has restricted the field of operation of independent consultants. The tendency to extend free engineering services as part of the sales programs of large companies similarly has encroached. Fortunately, industry by and large can not maintain engineering departments capable of coping with the unusual, and these peaks are surmounted by calling in the temporary services of independent engineering organizations. Yet the way of the consultant has not been easy, and the number of men who are truly independent, who have seasoned opinions based upon wide experience in many fields, is not large. This is distinctly the fault of government. There should be more utilization of men of the type of John F. Stevens called for service at the Panama Canal. If it were our practice in this country for government to employ independent engineers frequently, the number of such engineers would be greater. When government calls on the engineer at all, it usually attempts to do so on a niggardly basis. It appears to attempt to starve out a group upon which it distinctly needs to lean.

But part of the fault lies with engineers themselves. While we deplore any reluctance on the part of government to let the full light of reason play on its plans for engineering works, we must admit at the same time that the approach of engineers often has not been based upon a sufficiently broad consideration of these very matters. To show that a government engineering work will not pay an adequate financial return on the original investment is not necessarily sufficient to condemn it; yet engineers are prone to limit their considerations to a strict cost and yield basis. The building of a battleship can not be justified on this basis. The setting aside of a national forest should not be thus approached with limited logic.

Do not think that I advocate letting down the bars of strict reasoning to which all engineering works should be subjected. I have no sympathy with any waste of public money. To build a great dam to supply electric power in a region already amply supplied with power, to irrigate land in a region of no inhabitants, while farm land stands idle close by, to render navigable a stream that proceeds into a wilderness, are fool pieces of work in any language. Yet I would have the engineer join with the economist, the sociologist, the student of government, that he may grasp problems in their entirety.

Is it foolish to clear slums, and to cause living quarters to be built by subsidy from public monies, for the use of previous slum dwellers on a rental basis that returns only a portion of the direct investment? It may or may not be, and the answer can come only when the engineer works with the sociologist. It may be a decidedly good investment on the part of government from a strictly financial point of view, if the decrease in costs of police, health hazards, hospitalization and social decay, which follow slum clearance, offsets the direct cost of subsidy. But merely because the problem involves more than the matter of direct costs and direct revenues does not excuse government for proceeding without independent advice; it merely emphasizes the need for analysis by professional men of diverse types.

CONSULTING ENGINEERS IN EDUCATIONAL INSTITUTIONS

Both government and industry should support the independent consultant in this country, that he may be available in time of need. A duty also rests upon our educational system in this same connection. This duty may rest lightly, for the consultant with university affiliations can bring strength to the educational system itself. Much has been said on this subject, and some would block consultation by members of college faculties. This always would be a catastrophe, but especially so at present when the consulting engineering profession needs to be enlarged and supported. Moreover, engineering education must be real, conducted in an atmosphere of success and in close contact with industrial and governmental advance; and the consultant on the faculty can aid greatly in this regard. There are dangers in the relationship, of course, but they can be avoided and the benefits secured. The use of the name of university affiliation, without the substance of educational duties and responsibilities on the part of the consultant, is a perversion. Encouragement of consulting by university administrations should be accompanied by insistence that such contacts be on a high plane and such as to advance the professional standing of both the individual and his institution. The fees charged should be

on a dignified basis and such that there is no unfair competition with consultants who do not combine educational activities. There should be no use of university laboratories in consulting connections except where the institution is fully reimbursed for all costs of having the facilities present, and then only when there is no interference with the use of these facilities for their primary purposes. Educational institutions that have unique research facilities not available elsewhere should make them available so far as possible without impeding educational use, either directly or through those commercial organizations which perform research services for industry. This certainly does not mean, however, that an educational institution should do routine testing for industry where there is a commercial organization capable of performing the work. Industrial research within an educational institution may be a fine thing, when it carries its full costs, when its results become published, and when its presence adds to the educational process of training men capable of coping with industrial research problems after graduation. But neither the educational institution itself nor the consultant who is a member of its faculty should carry on activities that tend to lower the plane of independent consultants or independent commercial research laboratories. When these matters are realized, the presence of a consultant on a faculty may be of benefit to the institution and render available one more independent engineer for advice to government and industry.

There are many ways in which the individual engineer makes contact with government, and several in which a more intimate contact would be of benefit. One important way lies in the growth of the commission form of activity. These commissions usually, as in the case of the Federal Communications Commission, the United States Shipping Board and the Tariff Commission, are essentially groups of experts within the frame of government itself. So also are such units as port authorities, irrigation district authorities and the like, set up within our still flexible frame of government to unite the administration of regions having common technical character. These and similar units offer one promising mechanism by which to implement the specific actions of government in technical affairs. The engineer is an important member of all such bodies. By and large they have been decidedly effective. An important element, however, appears to be generally lacking in the movement. Usually such boards depend upon the technical knowledge of their own membership, supplemented only by the examination of witnesses who come before them. They are not amply enabled, by the act which establishes them, to increase their grasp and power by temporarily joining to their membership outstanding consultants with special knowledge of the particular problems before them. The independent engineer would find in such association many opportunities to be of genuine service.

Engineers and the Legal System

Another important way in which the engineer makes contact with government is in connection with the legal system, both in law enforcement and in the administration of justice in the courts. This is too large a matter to be treated adequately in an address having a broader subject, yet the point comes up inevitably. There is a real need for close association of scientists and engineers with the legal system at many points, especially in the patent system. The reason is clear. The determination of any legal question depends jointly upon the law and the facts. In a modern technical world the facts are beyond the comprehension of the layman. When dealing with a scientific or engineering subject, the most eminent jurist or attorney is usually decidedly a layman. The result is often sad. Decisions are rendered by judges to whom the facts of a case are in essence incomprehensible. Present procedure is expensive, indeterminate and sometimes ludicrous. Details of procedure aside for the moment, the real reason for this situation is the unwillingness of the legal profession to admit to a basis of partnership the scientist who understands the technical facts of modern civilization, with the attorney who understands the law. We have the spectacle of opposing experts, cross-examined by lawyers who have a week's cramming as a background in the subject under consideration, for the benefit of a judge whose scientific training ended at "Physics I." The childlike faith of most attorneys in this process of elucidating technical facts is beyond comprehension. To the technical man on the sidelines it is often evident that the discussion proceeds to about page 20 of an elementary text, when the true answer lies on page 500 of an advanced treatise. The general atmosphere, charged with suspicion, progressing at a snail's pace, is such that the majority of scientific men engage in legal matters just as little as possible. To expect men of great scientific attainment generally to be willing to take part in this procedure is expecting a great deal from the human race. Yet the members of the legal profession generally regard the presence of a technical adviser to the court, not subject to cross-examination, as an anachronism, and they are perfectly sincere and honest in the opinion. The dilemma is clear. The legal profession, which controls the system, can not itself or through its artifices dealy justly in the type of world in which we now live. It will not have the true cooperation of the best scientific and engineering minds in expeditiously arriving at justice until it welcomes them to something besides a subordinate status. In some of its phases, the legal system has been danger-

ously close to breakdown, and no small portion of this situation is the extent to which it is bogged down in a scientific morass. If breakdown comes, it will be the fault of the profession that molds its affairs and determines its form. Scientists and engineers stand always ready to aid in a matter of public concern and on a basis of professional partnership. In this connection the independent consulting engineer can be of real service in many ways, but space does not permit a detailed examination of them.

Throughout this address I have emphasized the value of independence. So long as this is maintained and there is the effective guidance of affairs by an independent professional class, I have no fear for the future. A true democracy, given this support, can compete with dictatorship and prevail.

FRONTIERS OF SCIENCE STILL REMAIN

It was independence of thought, freedom of action, the opportunity of a vast untamed domain that built this country and gave it the highest standard of living in the world. The geographical frontiers have disappeared, but the frontiers of science and technology still remain. Those qualities which built a trail into the wilderness can still build trails in the technological advance. The same qualities of courage, resourcefulness and independence which opened the nation are as necessary to-day as ever.

The growing complexity of life tends to make men cogs. The world is growing smaller, and it is becoming crowded. We "rub elbows" and find increasing dependence upon the activities of our fellow men. The race for economic domination becomes a race, from which we only partially are separated, for military supremacy. The burden on government increases, and the problems arising are more and more beyond the true comprehension of the proletariat. Intense nationalism is in the saddle, and everything, including freedom itself, toward which the human race always has aspired, is being sacrificed for a momentary advantage in the struggle. Nations are turning toward absolutism as a refuge.

Gladstone predicted the decay of democracy if the indigent voter found the power of his vote sufficient to seize arbitrarily and unreasonably the fruits of production. Jefferson himself, the father of American democracy, postulated as a necessary feature of a democratic régime that the bulk of the voters must be tillers of their own land. Whatever we may wish to modify in these opinions, one thing should be added in view of modern conditions. As the social machine becomes more complex and interdependent, it becomes increasingly easy for an aggressive group to disrupt it. The need for discipline is greater, the necessity for restraint of the asocial individual or group is more pressing. Individual freedom, always circumscribed, from the clan up, by the necessity of consideration of the rights of others, becomes inherently narrowed. The right to do this or that ceases to be a right when its performance injures a neighbor; and the ways in which each individual's acts reflect upon the security of his fellows are constantly multiplied. The democratic form of government is adapted to the maintenance of discipline only to the extent that great groups of varied peoples are ready and willing to discipline themselves. The failure to do so in other countries is the primary reason that the people have reverted to absolutism in the hope that it would prove benign. The immediate result, of course, has been to impose discipline, often harshly and in the extreme, to curtail radically individual freedom, and thus to create a state in which efficiency is secured at the sacrifice of much that makes life worth living. The plunge into absolutism is abrupt. The winning of individual liberty is a slow and painful process. Must all democracies go through this cyclic process? Can the great populace, which is governed by its intuitions, its emotions, its mass psychology, grasp this trend and preserve its stability? Moved by the persuasion of those with ulterior interests, who play upon their emotions, can they yet understand the voice of reason? It depends upon whether those who would bring to the people the accumulated wisdom of the ages speak in words that are powerful, genuine and capable of being truly understood; and then it depends only upon whether the people listen and are willing to be guided by the light of reason.

PROFESSIONAL MAN SHOULD MAKE HIMSELF HEARD

The free operation of professional classes, motivated by public zeal and altruism, is an anchor upon which our democracy depends to hold it through the storm. There is a great obligation upon the professional man to speak clearly, to insist upon being heard, to maintain his independence. This obligation rests heavily upon engineers.

To be a professional engineer in the true sense does not require that we have some special set of relationships to society and to the organizations of which it is made up. It does require that the primary motivation be the acquisition of scholarship and its generous application to the needs of man.

To be an engineer in these days is to bear a proud title. To be able and willing to speak true opinions on the complex technical affairs of the day, without prejudice and free from control, is a privilege that is becoming rare in the world. Insistent upon his prerogatives, kowtowing to no man, respected because he speaks a truth the country needs to know, the independent engineer stands as an important member of the professional class—a strong bulwark against disaster, which can guide our steps into the ways of pleasantness and into the paths of peace.