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ELECTRICAL ENGINEERS AND THE
PUBLIC¹

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MEMBERS of the American Institute of Electrical Engineers are pleased to refer to electrical engineering as a profession, and to the Institute itself as a professional society. When this occurs as a thoughtless repetition of fine-sounding words, it has little meaning, since mere repetition of an alleged truth does not make it a real truth, and it can be established as a real truth only by tracing it to some adequate foundation. But when those statements arise from a ripe understanding that the word profession means more than a mere organized vocation for earning one's bread, it has a high and commendable meaning. The word profession "implies professed attainments in special knowledge, as distinguished from mere skill; a practical dealing with affairs, as distinguished from mere study or investigation; and an application of such knowledge to uses for others, as a vocation, as distinguished from its pursuit for one's own purposes." This sets the professional man in a position which demands from him an attitude of service and of leadership. He must have a masterly knowledge, in addition to skill in a vocation. He must deal practically in the affairs or needs of men. His duties must be performed with a touch of disinterested spirit in addition to the vocational spirit of earning his livelihood. Such men have a duty to the public; and in the performance of that duty they must exert their influence on that thought and practise of the day

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¹ President's address of the American Institute of Electrical Engineers, delivered at the annual convention, Chicago, June 27, 1911.

which affects the welfare and progress of the nation. We as electrical engineers can not escape that duty, in case we wish to maintain the professional character of our occupation.

It may be retorted that questions relating to the welfare and progress of the nation are matters of economics and sociology, and not of engineering. The affirmation contained in this retort I will admit, but the negation I deny.

The theory of modern economics is built up under the influences produced by the introduction of steam power, with its potent agencies comprised in the steam railroad, ocean navigation and the use of steam power in industrial operations. These agencies are the creatures of engineers. Watt, Stephenson, Fulton, Ericsson, Boulton, Arkwright, Nasmyth, Bessemer, Siemens, Corliss, Holley and the other fathers of our modern industrial economic conditions were engineers; and it would be folly to deny to the parents an interest in their offspring, and equally folly to assert that the further developments of economic theory are not largely dependent on those industrial changes which are continually produced by the inventive activities of the great body of engineers. When I speak of industrial operations or industrial conditions, it must be understood that I include amongst industrial affairs the great means for transportation and intercommunication which are comprised in railways, telegraphs and telephones, in addition to the manufacture and distribution of products which involve the application of mechanical power as distinguished from animal power, and the manufacture, accompanied by distribution by pipe or wire, of the media for providing illumination and power. The engineers have precipitated these affairs on the world by their inventions; these affairs are in a large

measure the support of the engineering profession; and it is the duty of engineers to do their share in molding their various economic creatures so that the creatures may reach the greatest practicable usefulness to society. In fact, it would show a cowardly weakness to suggest that this duty should be avoided by men who are essentially responsible, as the engineers are, for the existing conditions. Theologians and physicians can practise their professions aloof from the ordinary affairs of the world, but the engineers associated with industrial events can not. Moreover, such an avoidance of their duty by the engineers, even if avoidance of responsibility were possible, would be particularly unfortunate in view of the fact that the professed economists and sociologists apparently do not yet hold themselves subject to all the requirements of professional men, but still interpret their duties as being more confined to the field of study and investigation than to applying their knowledge to practical affairs.

It may again be retorted that the tenets which I am advocating will lead engineers out of a professional spirit and into "commercialism." It is worth while to pause here to reflect on that point. The word "commercialism" strictly means the characteristics of business or commercial life, but custom has made it applicable to any undue predominance of commercial ideas in a nation or community, and it has thereby come to infer a willingness to establish the strife for money in a position of precedence over reason and righteousness.

It has been alleged that learning loses of its dignity by becoming fashionable. It has also been alleged that learning loses of its dignity by becoming useful. Of the latter, at least, experience has proved the contrary—happily for engineers who are proud of their profession, for engineering

is necessarily an embodiment of the useful application of knowledge and learning. Engineering, relating, as it does, to the application of the powers of nature to useful purposes, must necessarily bring its followers into intimate contact with commercial affairs in an age when, as in ours, the industries dominate commerce, and the abatement of war has reduced the importance of military engineering. The tenets which I advocate do not tend to entangle the engineers in the depths of "commercialism" with which they may come in contact; but, on the contrary, those tenets propose that engineers should safeguard and nourish their professional spirit by assuming a part in public affairs in a spirit of disinterest, for the purpose of guiding the useful applications of natural forces to the greatest practicable service to society. A true engineer is a devoted follower after truth. He differs diametrically from the devotees of pure "commercialism," who are strictly opportunists. He also differs from pure idealists, who are often notable for refusing to accept any advance unless it wholly meets their personal ideals. The spirit of the engineer rejoices in obtaining any move toward the truth, but is always seeking farther advance. This characteristic spirit has been manifested in men of great achievement in many walks of life. It is a part of the life of such men as Martin Luther, Gladstone and Lincoln.

Those who accept even in part the usual evolutionary doctrines which are summed up by Herbert Spencer in his view that progress occurs by successive differentiations and integrations producing development from the homogeneous to definite, coherent heterogeneity, will assent to the proposition that the modern giant corporation follows in the wake of the one-man business and the simple partnership in response to an inextinguishable natural law.

This is a case of natural selection. The progress of corporation development can not be prevented. It is one of the manifestations accompanying improved means of speedy transportation and inter-communication. Of the influence of the latter agencies, a learned and distinguished historian says, "Of all inventions, the alphabet and the printing press alone excepted, those inventions which abridge distance have done most for the civilization of our species. Every improvement of the means of locomotion benefits mankind morally and intellectually as well as materially. . . ." The possibility of, and indeed a necessity for, great corporate organizations came in the train of leading improvements in the means of locomotion and other beneficial inventions which abridge distance and subjugate time. Men of this age do not desire to relinquish the benefits of the improvements. We must, therefore, adjust our mental attitude to dealing properly with the situation; and in making the adjustment we must return to the old and approved recognition that a misdeed is a personal thing, and remember that responsibility for it can not be shifted from the personality of the man in responsibility to an impersonal aggregation entitled a corporation which he manages. In early days when English kings had great prerogatives in the government, and the doctrine of divine right, associated with the doctrine that the king can do no wrong, were still extant, the king was nevertheless limited to an administration of the affairs of the realm conducted, history tells us, in accordance with the laws, and, in case he broke those laws his advisers and agents were held responsible, and they were made personally answerable to the courts. History also indicates that this personal answerability of the advisers and agents had a tremendous influence on the conduct of

government and its relations to the public. In building up our industrial structure we must not overlook the plain guide board of history, and personal answerability must be established. But if we must establish personal answerability to the public, we must also establish fair and generous dealing by the public.

The building up of a great industrial nation in an honorable state of civilization is subject to many hazards—an error may cause injury to the structure that takes years or even decades to eradicate. It is, therefore, desirable to go cautiously and utilize the mature reflection of straight-thinking men who will give their thought to the subject. The forward route is untested, and real progress can be made only by judiciously combining teachings from the records of yesterday with experience of to-day to make a working theory for tomorrow. It has been suggested that a theorist should be defined as a man who thinks he may learn to swim by sitting on the bank and watching a frog. Doubtless, there are many such men in the world, but they are not theorists. The definition is as inaccurate as defining a black object as an object without color. Such men are only inexperienced, superficial or foolish. Theory, as the word is used by engineers, means a working hypothesis founded on all known facts and experience, which may be used to guide progress beyond the margin of past experience. Every successful, progressive man is a constant user of theory in this proper sense of the term. Every progressive step is made according to a theory of the man responsible for the move. Theory is not antagonistic to practise, but is founded on experience and is a guide to progress. Custom should be followed only when it has reason to support it. In the juncture now before us we must utilize the best theories of the corporation relations

and the rights of persons and property, and cautiously extend our practises accordingly. No body of men are better equipped for this sound and scientific procedure than a body of professional engineers; and few others are so fully and adequately trained for such procedure as engineers, for the reason that this procedure is in accordance with the every-day steps of their business life. Moreover, the engineers of experience are well adapted to grapple with the mighty problems of a new age, for the reason that an efficient engineer must associate audacity and sobriety in his spirit.

If my premises are tenable, and I believe them to be incontestable, the engineers have a special duty, as professional men who are trained and experienced in straight thinking, to use their influence for the establishment and support of right and reason in the dealings between the public and the public service corporations. The problems surrounding the public service companies in American cities, and their relations to the citizens, should receive particular attention by members of our Institute, for those problems and those relations have been largely brought to their present importance and prominence through the activities of electrical engineers.

The public service corporations are the natural outcome of the demand of the civilized world for efficient and rapid transportation and intercommunication, and the concurrent need as communities become immersed in peaceful industrial pursuits for ample and conveniently provided supplies of water, gas and electric power. They compose a comparatively new and mighty force in the social organism and the organism must be adapted to efficiently utilize this force, but the force must be prevented from dominating or warping the organism. There is no danger of the public service corporations becoming des-

pots as some people seem to fear, provided they are put under proper restraints, but society cannot afford to make restraints which of themselves are unnecessary or unfair. These corporations serve a beneficial end in our life, and their rights are as well founded and should be as well secured and held sacred as the rights of any citizens who are individually or collectively bent on any proper business pursuits.

Some people seem to believe that all public-service corporation men are either wicked or are liars or thieves. This has as little foundation in fact as a belief that all men in Spain carry mandolins or that Spanish women always wear mantillas. If such unjust, superficial and improper opinions are to have influence in this nation, then only misfortune and woe can be the outcome. It is necessary for all men trained in straight thinking to combat such folly and to cry out for fair dealing, one with the other, as between the public-service corporations and the public which they are established to serve. No engineer does his duty who does not stand with fidelity for equally square treatment *for* as *by* these corporations. These corporations are not here as vampires on society, but are here to serve the needs of the people in a reasonable and business-like way; and their proper objects can not be accomplished unless they are treated with reason and established in confidence. They obtain their income from serving the public, and they can not give generous service unless they are granted generous opportunities. When under reasonable restraints and supervision, as by properly constituted public commissions, they are more quickly responsive to public sentiment than could reasonably be expected of any publicly owned business organization of equal magnitude which could exist under our political conditions, and their

usefulness is proved beyond contradiction. Perhaps no man is more likely to observe these things than one whose professional practise, like that which has come to me, makes him retained adviser in some instances to public-service companies and in other instances to governments or municipalities, for he has to study fairness to each class of clients in all he does.

A barrier of distrust which exists between these servitors of the people and the people whom they serve is presumably due, on the one hand, to a memory by the public of misdeeds which were perpetrated before recent demands for reform brought about the establishment of adequate public supervision in prominent centers, and to a fear of the repetition of misdeeds where supervision and publicity have not yet been prescribed; and, on the other hand, to a certain reluctance by corporation managers to exhibit full and convincing frankness for fear that such frankness may be made the opportunity by unscrupulous politicians or persons with interested motives to crowd them to the verge of insolvency. These particular conditions of distrust could be obviated by means of the public itself owning the public-service properties and operating them in its own interest, but this is a drastic and undesirable alternative. Any fair-minded man of extended business experience who will study with unbiased intention the details of public ownership and public trading in the venerable and stable cities and states of continental Europe must be impressed with the reality that our inexperienced and shifting governmental bodies are wholly unadapted to cope with such responsibilities, or to make an economic success equal on the average to that now accomplished by the privately managed service companies, whether the measure of success be taken on the basis of service provided for a unit of payment or

on any other reasonable basis of comparison.

If the public could feel sure of the ingenuousness of corporation statements and statistics, and the corporations could be protected from unfair attacks made by ignorant, although, in many instances, educated, persons or persons with ulterior motives, the barrier of distrust to which I have referred would be dissipated as dampness is dissipated by the rays of the sun; but this cure requires a long step forward in the average line of progress, for it demands a supervision of the companies which imposes on them exact and ingenuous book-keeping associated with the presentation to the public of accurate and luminous statements of their business, and it equally demands that the public shall be required to yield justice to the companies with the same ample fullness as individuals seek it for themselves. A progressive step of this nature is always accomplished slowly and hesitatingly. I have observed in Macaulay's writings a paragraph which is graphic in illustration of our present situation. "Everywhere," he says, "there is a class of men who cling with fondness to whatever is ancient, and who, even when convinced by overpowering reasons that innovation would be beneficial, consent to it with many misgivings and forebodings. We find also everywhere another class of men, sanguine in hope, bold in speculation, always pressing forward, quick to discern the imperfections of whatever exists, disposed to think lightly of the risks and inconveniences which attend improvements, and disposed to give every change credit for being an improvement. In the sentiments of both classes there is something to approve. But of both, the best specimens will be found not far from the common frontier. The extreme section of one class consists of bigoted dotards: the extreme

section of the other consists of shallow and reckless empirics."

The public, misled or annoyed by the reluctance of some honest but overcautious managements to make frank public statements of financial results and present convincing statistics of operation, enraged by the acts of a few adventurers who from time to time have secured a speculative hold in the public-service field, and enticed by the arguments of individuals with ulterior motives, are likely to follow the radical leadership of demagogues or of honest but false empirics. This is a danger which seriously exists in states where no public supervision of the service companies is provided, and also in a lesser degree in states where such supervision has been established. The danger must be rolled back by the exertions of fair-minded and right-thinking men. A serious menace to the welfare of the nation would be caused if unfair dealing toward the public-service companies were established as a policy. A scrupulously frank and honest dealing with the public by the companies should be insisted on, but the public must be taught the importance of dealing, on its part, with an equally scrupulous fairness and a well-balanced generosity. It is here that I say lies a duty of electrical engineers to the public. It is to give of their time and brain to convincingly establish the facts (the *facts*, I repeat) which the public do not understand in regard to the business of the public-service companies, to indicate the means for rightly treating these new influences which we and our fellow engineers have been creating by our works, and to aid in establishing measures which will favor and sustain mutual confidence and fair dealing between them and the public. This is an obscure and difficult problem on account of its touching the edge of men's ambitions and men's passions, and it seems

at times to possess the opacity and insolubility of a mill-stone; but looking persistently and with care into what appears to be a mill-stone not infrequently proves it to be composed of reasonably transparent material. The members of our institute should take somewhat to themselves as professional men this obscure and difficult problem, and aid in its solution as a matter of their duty to the public.

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*TWENTY-FIVE YEARS OF OSMOTIC PRESSURE IN THE MEDICAL SCIENCES*¹

ON October 14, 1910, a large number of scientific men met in the lecture room of the Botanical Institute at the University of Utrecht, for the purpose of celebrating the twenty-fifth anniversary of Van't Hoff's theory of "osmotic pressure."² Professors Ernst Cohen and Hugo de Vries gave the principal addresses. The former, in his most inspiring and finished address, pointed out the invaluable services rendered by this great master to the science of chemistry.³ Professor de Vries gave a lecture on vacuoles and on this occasion emphasized the importance of physical chemistry in general and particularly that of the theory of osmotic pressure for plant physiology.⁴

¹ Translated from the German by E. I. Werber, Baltimore, Md.

² J. H. Van't Hoff, "Lois de l'équilibre chimique dans l'état dilué, gazeux ou dissous," *Kongliga Svenska Vetenskaps-Akademiens Handlingar*, 21, No. 17, October 14, 1885.

³ Ernst Cohen, "Een Kwart eeuw moderne Chemie," *Chemisch Weekblad*, No. 42, 1910 (Dutch); "Ein Vierteljahrhundert moderner Chemie," *Zeitschrift für Elektrochemie*, B. 16, No. 20, 1910.

⁴ Hugo de Vries, "Vacuolen, Verhandl. v. h. Provincial Utrechtsch," *Genootschap van Kunsten en Wetenschappen*, 1910, p. 36.

It would, I venture to say, amount to an unexplainable neglect, if the great body of medical investigators failed to give expression to the strong feeling of gratitude to this great scientist.

It gives me pleasure to present a brief account of the researches of de Vries and Van't Hoff and the indebtedness to them of the sciences referred to in the preceding.

In the first half of the last century it was already known that many substances have the power to attract water and also that this power was of great importance for the life of plants. In 1844, Mitscherlich made the first attempt to determine quantitatively this attraction. His figures, however, as well as those of later investigators, were by no means satisfactory.

As late as 1881 Pfeffer, in his text-book of plant physiology, deplores this fact and points out how important for the study of some of the phenomena of life it would be to know, even if only approximately, the water-attracting force acting in each and every substance contained in a plant cell.

It was in the year following (1882) that Pfeffer's hopes were fully realized by the great botanist Hugo de Vries, who actually solved the problem.⁵ He employed three biological methods, of which the *plasmolytic* gave the most reliable results. This method consisted in employing a salt solution strong enough to bring about a slight separation of the contents of the plant cell from the cell membrane, in other words, to induce plasmolysis in the cell. Since this separation of protoplasts (plasmolysis) was due to the fact that the power of the surrounding fluid to attract water was somewhat greater than that of the cell contents, de Vries concluded that solutions of other

⁵ Hugo de Vries, *Proces-Verbal der Koninkl. Akad. von wetenschappen te Amsterdam*, October 27, 1882; more exhaustively in *Pringsheims Jahrbücher f. wissenschaft. Botanik*, 14, 1884, p. 427.