SCIENCE

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE PRESIDENTIAL ADDRESS[1]

LADIES AND GENTLEMEN:

My first duty, as president of our great association, must be to read to you the following message from His Majesty The King:—

I am sensible of the distinction conferred upon my dear son, The Prince of Wales, in presiding at this year's meeting of the British Association for the Advancement of Science; for I realize that no member of my family has occupied this position since my grandfather was president in 1859. I can not do better than repeat the assurances then made by the Prince Consort on behalf of Queen Victoria, and express my deep appreciation of the all-important and ceaseless labors in the cause of science of those eminent men who enjoy the membership of your world-renowned society.

I propose on behalf of the association to forward the following reply to this message:

The members of the British Association for the Advancement of Science assembled at Oxford humbly beg to express to Your Majesty their loyal appreciation of the patronage extended to the association by your Father and Yourself, and of Your Majesties' repeated expressions of personal interest in its work.

The advancement of science is the constant object of the British Association; to give a stronger impulse and more systematic direction to scientific inquiry, to promote the intercourse of those who cultivate science in different parts of the British Empire with one another and with foreign philosophers, to obtain a greater degree of national attention to the objects of science, by removing those disadvantages which impede its progress, for the well-being of Your Majesty's realm and the general good of mankind.

My second duty is to try and tell you—if this be possible—something which you do not know already. I must admit frankly that, for a long time, the prospect of attempting this has weighed on me heavily. For a man who, along with the great majority of his fellow-creatures, can lay claim to no intensive scientific training, it is no light responsibility to be called on to address the annual gathering of the British Association. But, believe me, I do not intend to shirk that responsibility; for it seems to me that only

[1] Given by The Prince of Wales, Oxford, August, 1926.

by discharging it as well as I possibly can, shall I be able to show you how highly I value the great honor you paid me, when you added my name to those of the distinguished men who have been your Presidents in past years.

At first sight, it might appear a hopeless task for any one who knows nothing of science to talk to you, who know everything about science. But those who work in the scientific field will be the first to admit that no task is really hopeless, and, when I approached this one, I began to think I might perhaps find a few topics in which I could interest you. For, after all, science is only another name for knowledge, and any man who goes about the world with his eyes open can not fail to acquire knowledge of some sort, which, if he can express it, must appeal to any audience.

To adapt one of our most familiar sayings, the onlooker can see a great deal of the game. And I, for instance, though I claim no insight into pure science, can fairly claim an onlooker's experience of very many practical instances of science as applied to the needs of our civilization to-day. For some years past, in war and in peace, I have been privileged to have countless opportunities of examining, at close quarters, the concrete results of such applied science. In things military and naval, in factories, workshops, mines, railroads, in contact with the everyday problems of education, health, land-settlement, agriculture, transport or housing—in all such varied departments of human life, it has been borne in on me more and more that if civilization is to go on, it can only progress along a road of which the foundations have been laid by scientific thought and research. More than that, I have come to realize that the future solution of practically all the domestic and social difficulties with which we have to grapple nowadays will only be found by scientific methods.

It is from this experience, and with the conviction it has brought, that I should like to-night to tell you something of my general impressions of the bearing of scientific research on the daily life of the community; and to show how that relationship can be developed by the mutual cooperation of scientific workers and the state. I can not better embark on this attempt than by quoting to you the words of my distinguished predecessor, though without the hope that what follows will maintain the high standard which he set in his presidential address at the last meeting.

Professor Lamb, on that occasion, expressed confidence that the efforts of scientific workers "have their place, not a mean one, in human activities, and that they tend, if often in unimagined ways, to increase the intellectual and the material and even the esthetic possessions of the world. And in that assurance (he continued) we may rejoice that science has never been so widely and so enthusiastically cultivated as at the present time, with so complete sincerity, or (we may claim) with more brilliant success." This claim, by no means exaggerated, invites reflection upon the intimate association of the results of scientific research with the daily lives and affairs of every one of us. And it is a good thing to reflect upon this, even for those who have no sort of direct contact with scientific research, if only because the doing so may dispel an attitude towards science, which personifies it somewhat as the ancients personified the powers of darkness, and invests it with some of their sinister attributes. Such an attitude of mind is fortunately less common than it used to be. Professor Lamb, in the address already quoted, referred to a certain feeling of dumb hostility toward science and its works, which still survives. No doubt it does; but at least it has ceased to be vocal, as it was in the earlier days of the association. It became loud (for example) at two of the meetings in this very place. The later of these two occasions was the Oxford meeting in 1860, and the field of battle was the section of botany and zoology, in which the theories put forward in Darwin's "Origin of Species" were debated, in a manner which has passed into history, between Wilberforce, Bishop of Oxford, on the one hand, and Huxley and Hooker, on the other.

The earlier occasion, however, more appropriately illustrates, by contrast, the modern realization of our debt to science.

The second meeting of the association, in 1832, took place in Oxford. The university was not, at that time, without distinguished cultivators of science. The invitation to Oxford came from Charles Daubeny, who combined the professorships of chemistry, botany and rural economy, and the president was William Buckland, then canon of Christ Church and professor of mineralogy and geology. But a strong body of opinion resented the recognition of science by the university when carried to the extent of conferring honorary degrees upon four of the distinguished visitors. The famous Keble, moved for once to anger, referred to those who were thus honored as a "hodge-podge of philosophers." Their names were David Brewster, Robert Brown, John Dalton and Michael Faraday. Each of these men has left in the history of his own special branches of science an outstanding memorial. Brewster's researches into optics were his greatest scientific achievement; to our own gratitude he has an especial claim as the leader among the founders of our association. Brown's services to botany were unsurpassed; perhaps that of widest appeal is his very thorough investigation of the flora of the coastlands of Australia, made during the voyage

on which he accompanied Flinders in 1810–14; an early example of what may be termed imperial research. Dalton's name is identified for ever with the atomic theory, and he placed meteorology on a scientific footing. Faraday's labors provide one of the most wonderful examples of scientific research leading to enormous industrial development. Upon his discovery of benzene and its structure the great chemical industries of to-day are largely based, including, in particular, the dyeing industries. Still wider applications have followed upon his discovery of the laws of electrolysis and of the mechanical generation of electricity. It has been said, and with reason, that the two million workers in this country alone who are dependent upon electrical industries are living on the brain of Faraday; but to his discoveries in the first instance many millions more owe the uses of electricity in lighting, traction, communication and industrial power. Oxford, then, was not dishonored in the hodge-podge of philosophers whom she recognized in 1832. Nor will she recall with any disfavor the singularly doubtful compliment paid her on that occasion by another distinguished visitor, in whose mind the opposition must have rankled; the university, he said, had prolonged her existence for a hundred years by the kind reception he and his fellows had received. The association will scarcely make that claim to-day. But its visiting members will have ample opportunity to learn how, through her museums and laboratories, Oxford, within the hundred years thus tolerantly allotted to her, has kept pace with the scientific development of the period. It need surely be no matter for regret if science has worked for and is taking a place, not only in the university but in the schools, complementary with that occupied by the humanities. For complementary these two branches of learning must ultimately be. All the greatest exponents of scientific learning have been men of attainment also in letters.

The services rendered to mankind by the labors of outstanding figures in science, such as Faraday, or Kelvin, or Pasteur or Lister, are matters of too common knowledge to need insisting upon in this place. What is perhaps less generally appreciated is the extent to which, through the efforts of very numerous workers, the results of scientific research have been brought to bear upon many of the most pressing domestic and industrial problems of the day, and that the cooperation between the laboratory and the state (which means the community) has been greatly strengthened of recent years. The British Association has always supported such cooperation. One of its principal aims, as stated by its founders and maintained ever since, is "to obtain more general attention for the objects of science and the removal of any disadvantages of a public kind which impede its progress." In an article contributed by Brewster to the *Quarterly Review* in 1830, he asserted frankly that "the sciences of England" were "in a wretched state of depression, and their decline is mainly owing to the ignorance and supineness of the government" as well as to various other causes which he detailed. The same theme (if less forcibly stated) recurs in some of the earlier addresses from the chair of the association: the Prince Consort, for example, as president in 1859, thus indicates his view of the situation at that time—"We may be justified in hoping," he said, "that by the gradual diffusion of science, and its increasing recognition as a principal part of our national education, the public in general, no less than the legislature and the state, will more and more recognize the claims of science to their attention; so that it may no longer require the begging-box, but speak to the state, like a favored child to its parent, sure of his parental solicitude for its welfare; that the state will recognize in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

It may be fairly said that the position foreshadowed in those words is now, in a large measure, attained. The progress toward it was visible, if slow, down to the end of the last century; but the beginning of a new era was then marked by the establishment of the National Physical Laboratory. This was at first set up in Kew Observatory, a building which, as a laboratory for magnetic and meteorological observations, and for the standardizing of instruments, owed its maintenance to the British Association for thirty years from 1841, when, as a royal observatory, the government decided to dismantle it. The building proved incapable of extension to accommodate the whole of the work, and in 1900 Bushy House, Teddington, was placed at the disposal of the laboratory by the Crown. The laboratory, at its inception, was divided into departments dealing with physics, engineering and chemistry, and it possesses also the famous William Froude experimental ship tank. The investigations with which it has been so largely concerned—the testing and standardization of machines, materials and scientific instruments, researches into methods of measurement with the utmost accuracy, work on scale-models of ships, and the like—while of the first importance to government departments concerned with such applications of science, have also achieved many valuable results for industry in improving standard qualities, in indicating scientific methods applicable throughout a variety of manufactures, and thus in bringing about an improvement in the quality of their output for the benefit of consumers—which is to say, ourselves.

In historical sequence among the events which have strengthened interaction between science and the state, there follows the establishment of the Development Commission in 1908. Until that date the only agency for agricultural research in Great Britain was the classical experimental station at Rothamsted, a private benefaction; and the expenditure of the state on this prime factor in national economy was trifling. Since 1908 the Rothamsted station has been expanded to cover the whole field of nutrition and disease in the plant, while other institutes have been founded to deal with other aspects of agriculture such as plant breeding, the nutrition and diseases of animals, agricultural machinery and the economics of the industry. Not only are these institutes providing knowledge for our own farmers, but they form the training-ground for agricultural experts required by the Dominions, India and the Crown Colonies, which need no longer look abroad for their advisers. At the plant-breeding institute at Cambridge, Sir Rowland Biffen has provided several new wheats, of which two are generally grown throughout the country; the extra yield and value of these wheats must already have more than repaid the whole expenditure on agricultural research since the institute was founded. Among other examples of the value of research there may be mentioned the discovery of a variety of potato immune from the ineradicable wart disease, which a few years ago threatened the principal growing districts. The clearing up of the confusion into which commercial stocks of fruit trees had fallen has ensured that growers may plant orchards upon uniform stocks suitable to the soil and climate. And among the most important inquiries are those into the production and cleansing of milk, which have resulted in an entire reform of rationing, increasing the yield of each cow by one to two hundred gallons a year, and in freeing milk from the risk of contamination with disease.

Research into fisheries (which are administratively associated with agriculture) has become a matter of necessity in the light of evidence that even the vast resources of the sea have their limit, and can be injured if they are not exploited with due care and knowledge. Great Britain, acting in cooperation with the other nations who share with us the northern seas, has accomplished much in ascertaining the causes of the fluctuating herring supply, and has contributed notably to the study of the methods by which the stocks of plaice can be maintained. Research again is active in finding methods by which we can mitigate one of the consequences of our dense population—the pollution of our rivers and estuaries, and a method has been found whereby great supplies of shellfish that had been condemned are once more available as food. Some of my hearers will know, too, of the remarkable results obtained from the scientific study of the habits of the salmon. Though fishing has been described as "a fool at one end of a string and a worm at the other," the subject is not without its personal interest, I believe, to many learned men.

Reverting to the historical sequence, it is appropriate to recall, with gratitude for its labors, the constitution of the Medical Research Committee in 1913, under the Insurance Act of 1911: this has since (in 1919) been transferred to a committee of the Privy Council under the name of the Medical Research Council, and its funds are directly voted by parliament instead of being drawn from the contributions made by or on behalf of insured persons.

Research alone could provide the knowledge on which must be based all wise and effective legislation or administrative action in the interests of the nation's health. Yet until 1913 the state had played at best a subsidiary part in the organization of such research and the provision of its material support. Under the new conditions the state is actively concerned with the promotion and coordination of medical research towards conquest of those infirmities with which ignorance has afflicted humanity. A few only may be mentioned, which have rightly appealed to wide public interest. Insulin, a gift to science and to humanity from young enterprise and enthusiasm in the Dominion of Canada, is not only saving lives that were threatened, and restoring almost to normal health and enjoyment many that were crippled by weakness and restriction, but, as a tool of investigation, is shaping new knowledge that will influence all our ideas of the functions of the body, in health or disease. The discovery of the vitamins, those still mysterious and minute constituents of a natural diet, has brought understanding of various defects of health and of development, created for us largely by the blindness of civilization to dangers accompanying its progress, dangers which science can avert. Closely linked with the discovery has been the more recent development of knowledge concerning the need of sunlight for health, in man and his fellow animals as in plants. We know now that crippling deformity appears in the growing child unless he receives his proper share of the vitalizing rays of the sun, either directly or through the presence in natural foods of vitamins which these rays have produced. Sunlight, or its artificial equivalents, have some importance already in the treatment of disease; but a realization of its significance for health has a much greater importance in preventive hygiene. There can surely be no plainer duty, for a state charged with the health of an industrial civilization, than to promote with all its resources the search for such knowledge as this, as well as to provide for its application when obtained.

Among diseases which painfully affect the popular

imagination, cancer has an evil preeminence, largely on account of its mysterious, and therefore seemingly inevitable nature. For many years past a volume of investigation, supported by private benefactions and organized charity, has patiently accumulated knowledge of the beginnings of cancer and the conditions of its growth. Now, at length, there are signs of more rapid progress towards a penetration of its secret. Patience and caution are as necessary as ever; a new and exacting technique is still in development; but there is a new spirit of hope and enthusiasm. And it is reassuring to know that in this, as in other directions, the state is giving its direct support to investigation, and cooperating with the foundations due to private generosity.

Looking backward a dozen years or so, one may say that science was definitely, by that time, a working part of the machinery of the state, though, as we see now, not a part working at full power. The great war caused a broadening, so to speak, of the scientific horizon for men of science themselves in some measure, but for the layman in a measure far greater. We all were brought to recognize the applications of science as adding, it may be, in certain respects to the distresses of warfare; but also as immensely alleviating the sufferings caused by it, and as indicating many methods of strengthening the arts of defense —some of which methods are no less valuable in strengthening the arts of peace. The creation of the Government Department of Scientific and Industrial Research was an act which falls, historically, within the period of the war; but as an outstanding incident in the scientific advancement of national affairs, it certainly is not to be regarded as merely a war measure; it was once described as a near relative of "Dora," but that was a mistake. Nevertheless, by an odd freak of history, it needed the whole period of a century between one great war-time and the next—between the Napoleonic and the world wars—to mature the conception of a state department of scientific research. Some idea of this kind was clearly present in the mind of Brewster, and certain of his contemporaries, concurrently with his idea of the foundation of our own association in 1831; and later (in 1850) when he addressed the association from the chair, he claimed a strong advance in scientific and public opinion toward his views. Five years later a concrete proposal for the creation of a board of science, possessing "at once authority and knowledge," was put forward by the parliamentary committee of this association (a committee no longer existing); but our council at the time considered that the proposal had "yet to receive sanction from public opinion, and more especially from the opinion of men of science themselves." It was not, in fact, entirely owing to lack of prevision on the side of successive governments that the developments which have been outlined were so long delayed. There was an element of mutual distrust between science and the state—now, it may happily be believed, almost if not quite wholly removed. A strong body of scientific opinion was avowedly afraid (as Sir George Airy phrased it) of "organizations of any kind dependent on the state." It is to be hoped that modern developments have removed that fear. The progress of science can not be kept wholly within training-walls, and no one wants to try to keep it so. The waters of a river may be guided artificially to do the work of irrigation; but not at their sources, nor yet where, at the last, they percolate the soil. The guidance of scientific research, in its inception, lies with the genius of the individual; its results for the future may lie far beyond the realization even of the scientific workers themselves. The Oxford meeting of the association in 1894 supplies a simple example of this. There was a discussion on flight, in the section of mathematics and physics, opened by Hiram Maxim; and no less a leader in science than Kelvin afterwards described Maxim's own flying machine as a child's perambulator with a sunshade magnified eight times. Yet it was not many years before research in aeronautics had become the care of the state as well as of the individual; and the work carried out before 1914 under (what is now) the Aeronautical Research Committee led on to our wonderful development of aircraft during the war.

A recent report of the committee of the Privy Council for Scientific and Industrial Research shows that under the department there are eleven research boards, some of which direct the work of committees to the number of three dozen in all. These boards coordinate and govern researches in chemistry, fabrics, engineering and physics, radio, building, food-investigation, forest-products and fuel; and to these are to be added the board of the Geological Survey and the executive committee of the National Physical Laboratory. Under the general supervision of the Advisory Council there are upwards of twenty industrial research associations, formed in alliance with the same number of the principal industries of the country, for the purposes of scientific investigations connected with those industries. No attempt can be made here to review the whole field of work of these various bodies; but a few examples may be chosen for the purpose of pointing out what may be called their homely application. First, then, as to the building of the home. The Building Research Board was created in 1920, and in 1925, at the request of the Ministry of Health, considerably extended its activities. Researches are concerned with the study of materials from the chemical and geological aspects, their strength, weathering, moisture condensation on wall coverings, acoustics and

various other problems; these inquiries, together with the collection and supply of information both by publication and through an intelligence bureau, represent (as the report states) "an attempt to create a real science of building, to explain and supplement the traditional knowledge possessed to-day in the industry." It can scarcely be questioned that industrial Britain inherits a legacy of discomfort in the housing of its workers, with all which that implies, dating from a period when the building of the home lacked scientific as well as esthetic guidance. We need that guidance no less to-day, when the saving of labor is one of the main objectives of the "ideal home" and its fitments.

Next, a further word as to our food supplies. The Food Investigation Board directs committees concerned with meat and fish preservation, fruit and vegetables, oils and fats and canned foods. There is also a committee for engineering problems associated with the investigations; conditions of storage have been investigated on ships between this country and Australia, and problems of heat-conductivity at the National Physical Laboratory, while chemical substances suitable for refrigerants have been studied at the Engineering School here in Oxford. At Cambridge a low-temperature research station has been established on ground given by the university, and is working in cooperation with the university biochemical, botanical, agricultural and other laboratories. As for the investigations upon fruit and vegetables, the report may again be quoted, for it illustrates in a sentence something approaching the ideal of scientific cooperation brought to bear upon one particular home necessity, and (what is more) upon a particular and important branch of imperial commerce. "There is (it says) a closely knit scheme of work, which rests, on the one hand, in university schools of botany, and, on the other, in commercial stores scattered all over the country, where accurate records of results and conditions have been kept, and extends to the conditions of transport by ship, and overseas so far even as the Australasian orchards." Other directions of research which touch upon commonplaces of our daily life are those concerned with fuel, with illumination, with the deterioration of fabrics and the fading of colored stuffs, and—perhaps most homely example of all—with the application of scientific methods in the laundry industry. This will be good news to those of us who may have suffered, or may even be suffering to-night, from the torture of a collar which comes back from the wash with an edge like a surgical saw. It must be clearly understood that the few instances mentioned represent only a small fraction of the present activities of science in cooperation with the state. And expressed as they are here expressed, they may appear to wear an aspect even of triviality, because they deal with common things. But it is precisely because they do deal with common things that they are not trivial. There may be matter for amusement in that fact that science is concerning itself with the contents of the clothes-basket; but there is also matter for congratulation, and there may, in the future, be matter for sincere gratitude. Scientific research, properly applied and carried out, is never wasted. It may prove that a thing can be done, or that it can not be done; but even the proof of a negative may save the waste of further effort.

This attitude of the state toward science makes for an easing of the paths for the advancement of science in many directions; it marks a definite step in human progress, taken after long hesitation, but in itself new; and because it is new, we may believe with some reason that we live, not merely in an age of science, but at the beginning of it. The movement for cooperation which we have been discussing is not confined to this country. It has borne fine fruit already in other lands; and in particular it is active in our own dominions. The Indian Empire stands in a somewhat different category from these: there is here a tradition, so to say, for the application of science in its government, and the scientific results of its census investigations, its surveys, its agricultural, forestry and other administrative departments have long been famous. This is not to imply that brilliant scientific work has been wanting in the dominions—far from it—but the cooperative movements with their governments have followed that in this country and with a laudable promptitude. The trend of developments following upon all these movements has been similar broadly speaking; it is sought to take a comprehensive survey of the natural resources and industrial opportunities of each dominion, to explore the means by which science may be best applied to their exploitation, to provide, whether in state institutions or in university and other laboratories, for the pursuit of the necessary researches, to coordinate the work, and to ensure the dissemination of knowledge acquired. The nature of the researches themselves is conditioned to a large extent (though by no means wholly) by geographical circumstances in the respective territories: agricultural, pastoral and forestry problems, for example, are not identical in all of them, and that very fact adds to the interest and value of coordinating the results of research work throughout the empire. While problems may differ, solutions may point to a common end. Nothing but good can follow from personal contact between scientific workers in different parts of the empire. Nothing but good can follow from their researches if they add, as gradually they must add, to the wider knowledge of the empire not only among the workers themselves, but ultimately

among the whole body of informed imperial citizenship; not only in the overseas territories, but here at home. For us at home the empire is worth knowing. Our knowledge of it begins with the school lessons in geography and history—or should do so; no doubt the ideal here is yet to be attained. Such knowledge may become later of vital importance to those who wish to join the stream of overseas migration. The British Association, in pursuit of its policy of obtaining from time to time "reports on the state of science" in one department or another, has recently, through a committee of the Section of Educational Science, been collecting evidence as to the facilities existing in our schools for training boys and girls for life overseas. In the crowded curriculum of most schools these facilities, at any rate in their particular imperial application, are not conspicuous. Yet any labor which time allows us to spend, whether in school days or after them, upon the advancement of scientific knowledge of the empire, of the means and manner and environment of life in its component territories, must be well spent. The British Association has played its part in this advancement since, in 1884, it admitted the principle and established the practice of holding occasional meetings overseas. Those of our members who traveled from this country to take part in these meetings have had peculiar opportunities to meet and discuss each his own scientific problems with fellow-workers in the dominions—and it should be added with particular reference to those meetings which have been held in Canada that they have provided almost unique opportunities for personal contact between British workers in science and their American colleagues. Our traveling members have been able to see how science is cultivated in the universities of the dominions and in many other institutions; they have gained first-hand acquaintance with the special problems of one territory and another; and when they have returned home they have talked—as any one who travels the empire is impelled to talk. I have myself been guilty of giving way to this impulse on more than one occasion. Opportunities for travel are none too common for most of us, but most of us can at least cast our minds back to the exhibition at Wembley. Science herself, as an exhibitor, took a place there befitting her natural modesty. The scientific exhibit arranged by the Royal Society, admirable as it was, was confined to two rooms of the Government Pavilion. But was not a very large proportion of the entire exhibition, in point of fact, an exhibition of applied science?

It is impossible in the imperial connection to overstate the case for science. Sir William Huggins, in his presidential address to the Royal Society in 1901, said that "assuredly not only the prosperity, but even the existence of this empire will be found to depend upon the more complete application of scientific knowledge and methods to every department of industrial and national activity." To-day we see that application in much fuller progress than when Huggins spoke only a quarter of a century ago, and already we know how truly he prophesied.

It is not for a moment to be supposed, because the state has come to take a more active and practical interest in scientific research, that there is therefore any occasion for the lessening of interest on the part of societies and individuals. The state interest involves that other interest, and invites it. It can never become the exclusive function of the state to aid the individual research worker. The state may, and does, cooperate in aiding him, as for instance through the universities and the Royal Society. Nevertheless, there are whole departments of research which do not come within the range of public assistance, but are no less valuable because they do not. Therefore the support of science remains the concern of our scientific societies, educational institutions, industrial organizations and private benefactors, no less than it ever did; nay, the very fact that the state has lent its aid should encourage them to continue their aid and to reinforce it—indeed, there is satisfactory evidence that this actually happens. One example will suffice which indicates, incidentally, that from the purely materialistic point of view scientific research is not a luxury; for the community it is probably the cheapest possible form of investment. The government's fuel research station has not yet proved the commercial possibility of the low-temperature treatment of coal which would result in the more economical production of smokeless fuel, oils and gas; but in attempting this difficult task it has already, by results unforeseen when the task was undertaken, shown at any rate the possibility of economies for the state and for some of its major industries which are well in excess of the cost of the research itself.

There are parallels in many respects, as has been often pointed out and as often forgotten, between the periods of our history following the Napoleonic Wars and the Great War. The application of science in industry and daily life received impetus in the earlier of these periods in such directions as the introduction of steam motive power; it is receiving it now, as it has been attempted here to show. The auspices now are more favorable. Science is more powerful. Men more adequately and more generally recognize its power, and therein should lie a certain ethical value for it as offering a new point of view, in the manifold interest of which all can share. Should not the application of science, for instance, offer a new field for community of interest, not only

between one industrial organization and another, but within the whole body of workers in any single organization? But in order that the community may fully realize all that it owes, and all that it might owe, to the advancement of science, the channels of communication between research and the public mind have to be kept clear, maintained and widened. The non-scientific public is accustomed to view science as it might view a volcano; prepared for the eruption of some new discovery from time to time, but accepting the effects of the eruption without realizing the processes which led up to it during the preceding period of quiescence. The period of preparation by research before science can offer the world some new benefit may be long, but the scientific machine is always running quietly in the laboratory. There is an example ready to our hands. We recall the introduction of wireless telegraphy and telephony as a scientific gift of quite recent years. Do we all realize that it was here in Oxford, at the meeting of the British Association so long ago as 1849, that the first public demonstration of wireless signalling by means of electro-magnetic waves was given by Sir Oliver Lodge? It was the work of science to develop the methods then demonstrated until they have been brought to their present marvellous uses. On the other hand it is often the case, whether in industrial or agricultural, domestic or whatever application, that science has knowledge at command, awaiting use, long before mankind can be brought actually to apply it. Though we have quickened, we are not yet so quick in the uptake of the results of applied scientific research as, for instance, some of our commercial competitors. The public support of scientific research, upon all these grounds, should be accorded freely, with understanding, and with patience.

This brings me, ladies and gentlemen, to the close of what I have to say to you this evening. From my opening remarks, you will have gathered that I looked on you as an extremely formidable audience. That was when I only knew you, so to speak, on paper. Now that I have met some of you face to face—and hope to meet others in the Town Hall in a few minutes—I can only say that, if the presidential address has not the traditional weight of knowledge behind it, no president in the history of the association has ever received a more kindly and sympathetic welcome than you have given me to-night. I am deeply grateful for it.

One more duty remains to me—a duty to our hosts and to our guests. The university and city of Oxford have received us all with a high hospitality worthy of this town, to which all who have known it in the past always return with delight, and which never fails to throw its spell on those who see it for the first time. Their friendly reception has made it possible for those who have worked so hard at the organization of this meeting to bring it to the successful culmination which it promises to attain. Not the least successful feature of it is the large number of distinguished guests whom it has attracted from overseas. To all these I wish to offer a most cordial welcome with the sincere hope that they may always carry with them, as I shall myself, the most pleasant recollections of a memorable gathering.

GEORGE D. SHEPARDSON

PROFESSOR GEORGE DEFREES SHEPARDSON, for the past thirty-five years head of the department of electrical engineering at the University of Minnesota, died May 26, 1926, in Florence, Italy. He was absent this year on a sabbatical furlough, which he was spending with his family on a trip around the world.

Professor Shepardson was born in Cincinnati, Ohio, in 1864, the son of Reverend Daniel and Eliza Shepardson, who were the founders of Shepardson College for Women at Granville, Ohio. He graduated from Denison University in 1885 and received a Master's degree in 1888. He graduated in mechanical engineering at Cornell in 1889 and received the degree of doctor of science from Harvard in 1912.

In 1891 Professor Shepardson came to the University of Minnesota to take charge of the work in electrical engineering which was just beginning. The development of this department from that time to the largest of the engineering departments at Minnesota, is due to his leadership. He was the author of many text-books and technical and scientific articles.

He was a member of the jury of awards at the Buffalo exposition in 1901 and at the St. Louis exposition in 1904. He was a member of the American Institute of Electrical Engineers, National Electric Light Association, and the Society for the Promotion of Engineering Education, and a fellow of the American Association for the Advancement of Science. He was a member also of the honorary societies Sigma Xi, Phi Beta Kappa, Tau Beta Pi, Eta Kappa Nu.

Professor Shepardson was married in 1892 to Miss Harriet B. King, of Kings Mills, Ohio, who, with their daughter, Mary, survives him.

He was a cultured, Christian gentleman, very widely read in both the sciences and humanities. All his students will remember him for his readiness to help, his conscientiousness, patience, courtesy and kindness.

O. M. LELAND

UNIVERSITY OF MINNESOTA