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THE SPIRIT AND SERVICE OF SCIENCE[1]

By Professor **DAYTON C. MILLER**

THE CASE SCHOOL OF APPLIED SCIENCE

THE occasion of this convocation is the fifty-second commencement of the Case School of Applied Science, bringing to a close the fifty-fifth year of the activities of the school. Since my early school days I have been absorbed in the study of the philosophy of science; for forty-six years I have been a member of the faculty of Case School of Applied Science and have endeavored to promote the usefulness of science, with ever-increasing enthusiasm. I am convinced that science, in the broad sense, has arrived at the beginning of a new era in its history; this is "Commencement Time" for science, when it must assume new duties and obligations. My friend, Sir Richard Gregory, editor of the English scientific journal, *Nature,* has used a phrase so concise and explicit that I wish to adopt it as the title of this address, "The Spirit and Service of Science."

[1] The commencement address, June 1, 1936.

THE SPIRIT OF SCIENCE

The greatest effort of thinking man, since the beginning of civilization, has been to find a reasonable set of answers to his own questions concerning reality, origin, destiny, duty and hope. This organized body of highest truth constitutes philosophy; it is an inquiry into the first principles of things, as distinguished from science, which generalizes the scattered operations of nature into laws. The Greeks laid the foundation for our system of philosophy. The Eleatics before Socrates anticipated many modern theories, but rather by guessing than by research; a mythological explanation was assigned to a phenomenon of nature. Socrates was the first real philosopher; he introduced the method of hypothesis. Plato, the disciple of Socrates, concluded that the objects of real knowledge are not the ever-changing things of the sensible world, but are immutable, eternal objects which he called

"Ideas." Then Aristotle, the great architect of the whole structure of philosophy, constructed his logical system of truth, based upon "form" and "method," and made it the greatest contribution of the Greek mind to the progress of civilization.

The early philosopher had knowledge of only a very limited number of phenomena. As knowledge increased, the wise men began to "speculate" as to the causes of things; because there were not other known phenomena sufficient to test a theory, no general consensus of opinion was reached, and each philosopher had a system of knowledge of his own. After this came the ages of skepticism, gnosticism and scholasticism, "cloud-built, and mostly empty," until Francis Bacon arose in the sixteenth century and proposed a new method, based upon experimental research. He was the first to consider the philosophy of inductive science, and he wrote elaborate treatises on the theory of the new method of experimentation, though he himself made no striking or successful experimental contribution to the knowledge of nature.

Galileo, born in 1564, three years later than Bacon, is the real founder of the modern scientific method. This consists in making certain experiments and observations, and then by the use of the scientific imagination, induction, a hypothesis is formulated by means of which future particular facts can be predicted. Further facts are collected to prove or disprove the consequences deduced from the hypothesis; thus the number of facts to be examined becomes manageable, and we acquire rapidly a knowledge of the truth and ultimately are able to establish a general law of nature.

What is the real "Spirit of Science"?

Saint Paul says: "Prove all things; hold fast that which is good"; and Saint Matthew adds: "By their fruits ye shall know them." Taken together, these simple philosophical quotations give an almost perfect description of the scientific method.

Michael Faraday gave the following description of the correct attitude of a research worker:

> The scientist should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances; should have no favorite hypothesis; be of no school, and in doctrine have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature.

The late Arthur Gordon Webster, American physicist, formulated the scientific method in these terse words: "Think, calculate, plan, experiment, think,—first, last, and all the time, *think*." He contrasts this with the method commonly pursued: "Wonder, guess, putter, guess again, theorize."

In the scientific method, experiment is the source of truth, and it alone can give us certainty. The method requires a consideration of all the facts in the case, and the formulation of conclusions in accordance with the facts; if any part of the conclusion is uncertain or unjust, then researches must be undertaken to determine new facts by observation and experiment; this process must be continued and repeated, no matter how laborious, until the truth appears.

Experimentation proceeds largely upon the principle of cause and effect; it requires the control and quantitative evaluation of the factors involved, in order that definite relations may be established as laws of nature. Modern technique has made possible great precision and certainty. The sciences involving accurate measurements are designated exact sciences in distinction from sciences which depend upon the description and classification of phenomena. From the quantitative relations, the scientist may predict a future event, or the engineer may design a structure adapted to a specified use.

A truth once discovered always remains a truth; new truths are added and knowledge grows, evolution, not revolution, being the method. The great object of human endeavor, beyond mere animal existence, is the attainment of knowledge; this, together with the altruistic purpose of preserving and transmitting knowledge for the enrichment of the lives of future generations, are the motives which have created our great universities, libraries and museums.

The gospel of science is the gospel of work. By nothing but patient toil and the quiet thought which it brings, can a scientific habit of mind be acquired. Scientific investigation is not often undertaken with personal profit in view, and frequently the researcher is denied not only the luxuries of life but even what other successful men regard as the necessities. The discoveries of the scientist are not jealously kept within the precincts of the laboratory, but are offered freely to the world.

Happily, at times, research becomes of absorbing interest and gives pleasure and satisfaction beyond that of most other occupations. The worker in science must count this as his compensation instead of the monetary rewards which the man of affairs confidently expects.

Paradoxical as it may seem, all exact science is dominated by the idea of approximation, that is, completeness and perfection are never attained. An experimental result is always given with a statement of its "probable error," indicating its relative precision and certainty. Who ever heard of a politician concluding his speeches or of a theologian prefacing his creed with a statement as to the probable error of his opinions? It is an odd fact that subjective certainty is inversely proportional to objective certainty;

this contrast is illustrated by the dogmas of art and of science.

It is evident to a sympathetic observer that the relations between men of science and the general public are not always such as to secure the best interests of both. There is a wide-spread opinion that a scientist is a sort of recluse, a book-worm, a high-brow, who has cut himself off from communion with his fellows, and especially from what the business man calls practical affairs, and that he has become an impractical, visionary "theorist" who is almost to be pitied; that he is a scientist merely because he is a fool who does not know enough to make money. To the credit of the scientist, it may be said that he is usually regarded as a harmless creature and that to render him encouragement and assistance is often regarded as a virtue.

It frequently happens that when new ideas are brought forth, evil-minded persons take advantage of them for selfish purposes; in this manner the contributions of science have been perverted to base ends, subjecting science itself to unjust criticism. Much of the criticism is caused by the fact that the scientific method is, in general, evolutionary, that is, it tends to produce changes in accordance with increased knowledge and improved conditions. The politician violently opposes the application of methods involving the open presentation of a situation, and the drawing of conclusions based upon a complete study of all the facts. Many ecclesiastical bodies obstinately resist changes of doctrine or procedure and refuse even to consider newly discovered facts which bear upon their affairs. The ignorant and uninformed in general manifest an astounding intellectual inertia and refuse to modify their superstitions.

The scientific dilettante, or worse, the charlatan, is often much nearer to the public than the honest man of science, and the inability to discriminate results in disaster to both the scientist and the public. The astounding prevalence, in this enlightened day, of the horoscope, the astrologer and the soothsayer is a disheartening illustration of this fact.

In our universities even, often there is a lack of adequate appreciation of the scientific method. Scientific and humanistic studies are presumed to be antipathetic and to represent opposing qualities; science being associated with that which is cold and mechanistic in our being, while the development of the more spiritual parts of man's nature is attributed to other departments of intellectual activity. However, in truth, direct contact with nature and inquiry into her laws produce a habit of mind which can not be acquired in literary fields and which is associated with a wide outlook on life more often than is commonly supposed.

In quite modern times the professors of scientific, and of unscientific, subjects have been denominated "brain-trusters," sometimes in contempt or ridicule, but, I hope, sometimes with respect. If the brain-truster is worthy of his classification, he will adhere to the specifications of a true scientific researcher, and he will find justification.

When attending the meeting of the British Association for the Advancement of Science, three years ago at Leicester, during a procession of the members I stood on the curb to obtain photographs of Sir Oliver Lodge and some of the other notables. Beside me stood two of the citizens of Leicester, evidently of the common people. As the scientists were passing, one of the citizens said: "Ah, them has brains!"; and his companion replied: "Aye, I wish I had some too," expressing the noble virtues of humility and respect for his superiors.

SCIENCE AND PHILOSOPHY

Some have doubted that the modern scientist possesses the idealism and faith necessary to the true philosophy. The scientist has been accused not only of not having any ideals of his own, but of being bent upon destroying the ideals of others. It may be incumbent upon the man of science to proclaim his philosophic conclusions as well as to announce the spectacular conquests of nature.

Existence is a struggle, and we are urged on by a hope of comfort and gratification and of a life of happiness. Every contemplative person, in the beginning, expects to formulate a philosophy of life which will indicate the ends to be striven for, and such that it will stimulate the motives of action and lead to the satisfaction of attainment. The term of existence is so short and incomplete that in this struggle the happiness acquired by an individual varies greatly and in a manner that often seems unjust. In order that life may be worth living for an intelligently thoughtful being, there must be something more than the momentary results of action, whether these be rewards or punishments; there must be a goal towards which integrated human accomplishment advances. In mathematical language, existence is an infinite series of individual lives, some positive, some negative, some of the first power and some of higher powers, but the sum of the series must approach a limit which is an ultimate good far transcending in importance any single term of the series, and the nature of which may be quite independent of that of any single term. This final sum of the series may be called an "ideal" which extends beyond the experiences of this life, which becomes an eternal verity, and constitutes reality, and our philosophy wishes to describe and even to explain it.

At Princeton University, forty-nine years ago, being determined to find a metaphysical basis for experimental science, I joined a group of perhaps ten seri-

ously minded students who went once a week to the library of President James McCosh. We literally sat at the feet of this great Scotch-American philosopher while he expounded a philosophy of realism, opposed to idealism on the one hand and to agnosticism and materialism on the other. Those of my teachers who have impressed me above all other men are Dr. McCosh, Charles A. Young, the Princeton astronomer, and Cleveland's own Edward W. Morley, a triumvirate of profound and scientific philosophers.

Realism holds that there are real things and real "values." We can not by pure reasoning prove the existence of either mind or matter. If we are ever to get hold of reality, we must seize it at once, and having whole-heartedly accepted it, we are to proceed to develop a system of philosophy which will be fundamentally scientific. I am prepared to adopt as the realities which constitute the universe three manifestations of absolute value: things which are eternally true—*science;* things which are intrinsically good—*ethics*—and things which are inherently beautiful—*esthetics.* There are not three different worlds of values; there is one universe of reality, a unity of the good, the true and the beautiful. And more, we must believe in the inherent and everlasting ability of mankind to progress towards an ultimate ideal or destiny, which requires that one's life be so ordered as to be in harmony with these eternal virtues. Such a life brings the greatest happiness and satisfaction.

It is not our observation or induction of these things that makes them realities; rather, we are sure we know them, we seek them, we cling to them, we are not satisfied with anything less nor indeed with anything else. This realistic philosophy is accepted in accordance with what the scientific man calls a "postulate"; others may well say it is accepted as a matter of "faith." Such a system of philosophy is not new, in fact, it is one of the oldest systems.

The aim of life should be to secure the greatest development and manifestation of these qualities, and a life based upon such an ideal should bring the greatest happiness and satisfaction. Mere physical pleasure is a part of the reality of nature, and its pursuit is not only allowable but is laudable. However, the foolish man often overlooks the fact that nature is scientific and ethical in its very essence, as well as esthetic and epicurean, and that sooner or later he must submit to the inevitable consequences of his actions; the wise man knows that the most exquisite and satisfying pleasure comes to him who practices his enjoyments with regard to the unity and solidarity of nature. The universe does not keep its ethics in one compartment and its beauty in another, to be sampled as one selects; it is true throughout, it is beautiful throughout, and it is ethical throughout.

There is no conflict between science and real religion. It is not within the province of religion to circumscribe science nor to limit beauty. It is no part of the work of science to prove or to define religion. Ethics is just as real and just as fundamental as science, but not more so. The study of science should and usually does increase one's appreciation of the principles of ethics. The study of the laws of physics gives one an enhanced appreciation of the beauties of music, the subtlest of all the arts. The contemplation of any part of the universe of reality enlarges one's understanding of the whole.

I would quote from the writings of several physicists, with each of whom it has been my great privilege to be personally acquainted.

Henry A. Rowland, the first professor of physics of Johns Hopkins University, became the leading physicist of America. His love of truth held him in supreme control. He describes a scientific observer in the following words:

> I value in a scientific mind, most of all, that love of truth, that care in its pursuit, and that humility of mind which makes the possibility of error always present more than any other quality.

Lord Kelvin, England's greatest physicist, said:

> I believe that the more thoroughly science is studied the further does it take us from anything comparable to atheism.

The late Lord Rayleigh has said:

> It is a strange world, and perhaps the strangest thing of all is that we are here to discuss it. I may say that in my opinion true science and true religion neither are nor could be opposed.

The late Michael Pupin, of Columbia University, upheld upon every occasion the high ideals of science, and said:

> The worship of eternal truth and the burning desire to seek an ever-broadening revelation of it constitute the mental attitude which I call "idealism in science."

The late Dr. John A. Brashear, of Pittsburgh, with whom I became acquainted in my college days, has always been a source of inspiration. In the making of astronomical instruments of precision he was the peer of any man of his time. Much as he loved and revered the science of astronomy—and surely no man ever loved it more—he said:

> The science most worth while in this world is that of extracting sunlight from behind the clouds and scattering it over the shadowed pathways of our fellow travelers.

His ashes, together with those of his life-long helpmate in good deeds, lie in the crypt under the great

telescope of his own construction in Pittsburgh. The marble plate bears the inscription:

We have loved the stars too fondly
To be fearful of the night.

CONTRIBUTIONS OF SCIENCE

That science develops a broad and inspiring view of the universe is evident; the spirit of science is surely noble, but what of the fruits of science, what does it signify in relation to our practical everyday life? What "service" can science render? The results of scientific investigations have contributed beyond measure to the alleviation of human suffering, have become of very great value in many industrial operations, have added incalculably to the entertainment and pleasure of human beings, and have attracted the widest possible attention; it would require a long series of lectures to give even the briefest outline of these contributions of science.

A few conspicuous scientific achievements of recent years are the telegraph, cable and telephone; the phonograph; wireless telegraphy and radio-telephony; electric generator, motor and electric light; photography and motion pictures; x-rays and radium; and aviation. Each of these advances came from simple research in pure science, carried on laboriously and patiently by a sincere scientist, who worked in his laboratory, his one purpose being to discover the secrets of nature, to find the essential truth; and without expectation of mercenary reward. Every one of these scientific discoveries has become the basis of an enormous industrial enterprise.

It can easily be shown that the triumphs of industry, which have so enriched many practical men, would never have existed if only these practical men had lived, and if they had not been preceded by disinterested scientific men, who died, poor, who never thought of utility. Mach, the Austrian philosopher, has said: "What these 'fools' did was to save their successors the trouble of thinking." Since it seems to be necessary to think for those who do not like thinking, and as they are many, each one of our thoughts should be useful in as many circumstances as possible! For this reason, the more general a law is, the greater is its value.

Not only has a scientific research started profitable industries, but many times a further research of a purely scientific character has been necessary for the continued success of the enterprise.

The first Atlantic cable was laid in 1858, according to specifications of the practical engineer; it was operated with difficulty for two months, when it failed completely because of faulty design and improper operation. William Thomson, afterwards Lord Kelvin, then a young professor of physics in the University of Glasgow, carried on extensive theoretical and experimental investigations which solved the difficulties; a second cable, laid in 1866, operated successfully.

After the telephone had been in practical operation for twenty-five years, it was still impossible to communicate over wires more than a few miles in length. It was the theoretical and experimental researches of Heaviside in England and of Pupin in this country, made in accordance with the principles of pure science, which rendered long distance telephony possible.

In many cases where the application of scientific principles is not so evident, yet the debt to science may be even greater. It has recently been stated that the steel industry at the present time is making use of at least five fundamental scientific discoveries which originally were worked out in college laboratories by private investigators, the loss of any one of which would make the steel industry impossible.

Lord Kelvin made many scientific discoveries and inventions which are useful in navigation; it has been estimated that no less than two hundred of these are involved in the operation of a modern ship.

It is often supposed that the marvelous development of aviation within recent years owes nothing to pure science. It was not a practical engineer who made the first flying machine; it was Samuel P. Langley, secretary of the Smithsonian Institution, of Washington; he made experiments in a physical laboratory, according to scientific methods, which led to the discovery of the theory of true flight. After flight was possible, it required many other scientific discoveries to make it practicable. When Charles Lindbergh made his "lone eagle" flight to Paris, he declared that the marvelous achievement was due in large measure to the induction compass with which his plane was equipped. This is an instrument based upon scientific principles which were developed in the physical laboratory.

Dr. Irving Langmuir has stated that the recently introduced gas-filled incandescent lamp saves $2,000,000,000 per year, or more than $5,000,000 per night, in the cost of electric illumination.

The illustrations given have all been taken from the science of physics. Other examples could be chosen from such sciences as medicine, chemistry, mineralogy, biology and others, which might be even of greater importance in their commercial aspects or in their relations to human welfare.

A most important semi-public scientific institution, devoted to pure science and equally to the uses of science, came into existence because of conditions created by the Civil War. Upon the recommendation of President Lincoln, the National Academy of Sciences was chartered by Congress in 1863. The

charter provides that "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States."

The National Academy in this country corresponds in general to the Royal Society of London, and to the Academy of Sciences in France. The Academy membership, limited to three hundred persons, consists of groups representing all the natural sciences. Election to the Academy is based only on distinguished services to science, and is the greatest scientific honor that one may receive.

The National Research Council of the National Academy of Sciences was organized in 1916, in accordance with an executive order signed by President Wilson, as a measure of national preparedness. The Council was perpetuated, at the further request of the President, on a peacetime basis; for the purpose of "stimulating research in mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare."

The Science Advisory Board was created by President Roosevelt in July, 1933, "with authority, acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council, to appoint committees to deal with specific problems in various departments of the Government."

The headquarters of the National Academy of Sciences is in Washington, where it has its own building on Constitution Avenue facing the Lincoln Memorial; the building is of great architectural beauty and is a worthy Temple of Science.

SCIENCE AND PUBLIC SERVICE

After having called attention to the beauties of the scientific method, and having mentioned some of its wonderful achievements, a very practical question which may be raised by those of the audience, and especially by the members of the graduating class, is: "Just what are we individually expected to do about it?"

Obviously, it could not have been according to a specified purpose that Madame Curie discovered radium, that Galileo invented the telescope, that Faraday discovered the laws of electromagnetic induction, or that Newton discovered universal gravitation. Even though you can not make discoveries at will, you can nevertheless deliberately make use of the scientific method to solve known problems, with the expectation of obtaining better results than by the use of any other method. Probably not many of you will adopt pure science as a profession, and it is to those who do not do so that my message is especially directed.

The primitive motives of selfishness and greed are at this moment rampant the world over, and, feeding upon democracy, are threatening the overthrow of law and order and the destruction of the cherished institutions of our higher civilization. The scientist has given man control over immeasurable forces of nature, but has not yet taught him to apply scientific methods to the control of his emotions.

Professor R. A. Millikan says:

> The future progress of the world depends upon whether man uses the old jungle method of thinking or whether he will make his thinking scientific.

Sir Richard Gregory, of London, the editor of *Nature,* says:

> Whether anything worth preserving can long remain in our civilization under present conditions and leadership may well be open to doubt. If freedom and democracy are to endure, this constrains the man of science to hold a watching brief, lest the name of science be taken in vain and the power of the franchise be abused by an uninstructed electorate.

Lest there be misunderstanding, I may state emphatically that I am not making a plea nor even suggesting that the affairs of state and society be turned over to the professional scientist. But I am proposing, indeed am demanding, that the man of public affairs shall adopt the philosophy and methods of procedure which have been developed in the world of science.

Sir Frederick Gowland Hopkins, in his recent presidential address before the Royal Society of London, said:

> What seems to be really desirable is some method of closing the gap between the mind and outlook of the publicist and those of the trained scientist. It is time, perhaps, that the building of a bridge should begin on the scientific side of the gap.

A scientific theory, as already mentioned, is not a vagary of a dreaming mind; it is a statement of a fundamental truth, an explanation of real things based upon practical experience, and it is acceptable only in so far as it conforms to reality. What can be more real and practical than the theory of gravitation or of the sustaining power of the air upon an airplane, though both are invisible! The scientist is not a mere theorist, but, far more than the man of business, he comes into direct contact with practical realities; it is

the scientist who meets real difficulties and knows how, or learns how, to overcome them. To make a shrewd guess as to future values or to drive a sharp bargain is not the way to become acquainted with the real, practical things of this world.

How unscientific are the methods of expediency, common in commercial activity and embodied in such processes as "promotion," "publicity" and "high-powered salesmanship"! In "selling the public" some facts are usually set forth, but rarely are all the facts employed. Certainly a promoter may be honest, and still not set forth all the facts, and the buyer may receive full justice, if both have the scientific state of mind; but when the scientific attitude is not present, what calamitous opportunity for fraud and injustice lies in the current methods!

The scientific method is greatly needed in the solution of social and moral problems. It is strictly in accord with the scientific view that a successful form of government requires of every citizen, individually, a strict obedience to law and order. "Personal liberty" is not based upon a consideration of all the facts, it is usually only personal license and selfishness, and when one claims this as his right in justice, he denies equal justice to others.

A few days ago I stood in front of the impressive building of the United States Supreme Court in Washington; the well-known legend on the frieze caught my attention and I pondered its significance. It did *not* read: "Complete justice for each individual"; instead it proclaims: "Equal justice under law"—a scientific rather than an emotional "motto"!

Referring to the dictionary, "politics" is there defined as "the art or vocation of guiding or influencing the policy of government through the organization of a party among the citizens, including, therefore, not only the ethics of government, but more especially, and often to the exclusion of ethical principles, the art of influencing public opinion, of attracting and marshalling voters, and of obtaining and distributing public patronage." "Diplomacy" is defined as "dexterity and skill in managing negotiations of any kind, with the view of securing advantages." Surely here are needed methods involving the highest ideals and the truest philosophy.

The scientific method is needed in municipal and state affairs. The "business manager" plan of conducting public business is scientific in its original intent, and it should be sustained to the utmost. Every citizen of the state of Ohio should apply the scientific method to the study of the principles of taxation, and our law-makers should use the method in devising and passing adequate and just tax laws.

In national and international affairs the just settlement of several important questions demands the application of the strict scientific method. Among such questions are the coordination of the various departments and bureaus of the government and the budget system of making appropriations; the tariff on imports; the settlement of foreign war debts; and even the question of war itself. The League of Nations is, when honestly considered, the most impressive application of the scientific method which the world has known, and perhaps, ever can know. How unscientific it is to consider it in a partisan spirit!

The late Professor T. C. Mendenhall, one time director of the United States Coast and Geodetic Survey, fifty-six years ago gave an address as president of the American Association for the Advancement of Science, in which he said:

> The computation of the trajectory of a planet may be an easier task than forecasting the true policy of a great republic, but those qualities of the human intellect which have made the first possible should not be allowed to remain idle. The presence of one or two men of science in each branch of the Congress would be of decided advantage to the whole country.

We do not recall that the voting public has ever sent a senator or representative to Congress primarily because he was a profound scientist. In contrast, it long has been and is now the custom of the electorate of Great Britain to send representatives to the British Parliament solely because they are eminent men of science. May we dare to hope that some of the graduates of Case School of Applied Science may be sent to the legislative branch of the government?

Not only should the judgment and taste of the general public be cultivated to secure a greater reliance upon the scientific method, but since men of science have exhibited an inexcusable apathy towards matters of public service, it is necessary to exhort them to consecrate their abilities and knowledge to the betterment of life in general and to assume the responsibility not only for making new discoveries but also for the beneficent use of these new powers, lest they be applied destructively. The public may justly demand that the active interest of the man of science in public affairs shall not be less than that of other men.

TO THE GRADUATING CLASS

In addressing you, the members of the graduating class of Case School of Applied Science, I do not plead for the study of specific sciences, such as astronomy, geology, physics and chemistry; you are already well versed in these subjects, and I hope you will never cease to enjoy their continued advancement. While these sciences have been developing, the broad "spirit of science" has grown into our intellectual processes and there has been evolved the perfected method of philosophy.

You, young men, have for four years had the advantages of the best training for life's duties that the universities know how to give. It is expected that you will be honest and successful private citizens; and of greater moment, your home city, your state, your nation and your Alma Mater, have the right to expect of you the highest type of leadership and the manifestation of the highest ideals in public affairs, for the benefit of all.

Plato said: "Might is right"; two thousand years later Milton said: "What is strength without a double share of wisdom?" and Browning adds: "The great mind knows the power of gentleness, only tries force because persuasion fails." Finally, Lincoln said: "Let us have faith that *right* makes might; and in that faith let us dare to do our duty as we understand it."

If the ideal of democracy is to be attained, I believe that the application of the true scientific spirit to the affairs of state will assist more than anything else at the present time. You are certainly of the chosen people, and I beseech you to accept the responsibility in all seriousness.

Probably, every graduating class that ever passed from college halls has been told that upon its shoulders rest the burdens of the world. It is a statement which, however trite, is, nevertheless, true. I have spent a lifetime teaching college students, and I know that each year the lessons must contain the same fundamental principles as were taught a year ago, ten years ago and even hundreds and thousands of years ago; but the lessons should be given with ever-increasing effectiveness as the world's experience and knowledge increase. I have the privilege of giving you the last lesson of your college course, for within the half-hour you will have graduated; in concluding this lesson on the old subject of the opportunities and responsibilities of youth, I am counseling you to make the fullest possible use of the spirit and service of science.

SCIENTIFIC EVENTS

THE EDWARD GREY INSTITUTE OF BIRD STUDIES

IN the issue of SCIENCE for September 18 there was printed an appeal for subscriptions for the three-fold memorial which it is proposed to establish in England to commemorate the late Viscount Grey of Fallodon. The third object of the memorial is to develop the existing scheme of research maintained by the British Trust for Ornithology at Oxford, of which university he was an undergraduate and in later years the chancellor, to form a permanent Institute of Bird Studies, to which his name would be attached.

In pursuance of this object it is proposed to establish the Edward Grey Institute of Bird Studies, which is described as follows:

> Lord Grey's love of wild birds, and his genius for expressing the widely shared delight in watching them, won him the affection of thousands of people in England and oversea. As chancellor of Oxford University he warmly supported the attempts then being made to create a team of field observers centered on the university.
>
> It is therefore fitting that his memorial, after provision of the statue or bust, and acquisition of Ross Castle, should be a permanent endowment of bird-watching in the British Isles, under university direction, and styled the Edward Grey Institute of Bird Studies. This would provide a small but suitably staffed institute situated at Oxford, to furnish help and advice to every one needing them on matters relating to wild birds and their habits. It will house the only library in the British Empire devoted to books, MSS., photographs and films about living wild birds and will initiate cooperative inquiries. It will not duplicate the work of any existing body, but will fill a conspicuous gap.
>
> The British Trust for Ornithology, in collaboration with the university, has already made a good start in this direction. Teams of observers are successfully at work on experimental investigations, and a valuable library has been presented by a number of ornithologists. A generous response to the Viscount Grey Memorial Appeal will endow Great Britain with a model institute which will have no match in the world as a center for helping voluntary effort in the study of wild birds. Such a center will keep alive the memory of Lord Grey by continuing his work of finding out how birds live and of stimulating more understanding of the pleasures and rewards of bird-watching.

THE MEDICAL CENTER IN JERSEY CITY

THE laying of the cornerstone of the Medical Building of the Medical Center of Jersey City by President Roosevelt was planned for the morning of October 2. He is to be welcomed by Mayor Hague and introduced by Senator A. Harry Moore.

The Medical Center is being financed by Jersey City, Hudson County, New Jersey, and the Public Works Administration. The Medical Building will be one of seven large structures of the skyscraper type and several smaller buildings, some of which are ready and others near completion. The center will provide ninety-nine floors for hospitalization, with beds for the accommodation of 2,000 patients.

The Surgical Building, the Staff House and the Nurses Building are completed. The Medical Building is under construction on the site of the old Jersey City Hospital. This building will cost $4,545,000 and is financed by Jersey City and the Public Works Administration.