

not less than one year nor more than six years before the awarding of the prize, shall have made in the judgment of the trustees the most important discovery or investigation in electricity or magnetism or radiant energy."

This gift was received in December, 1907, and the first Comstock prize will be awarded at the present meeting.

General Comstock was a distinguished engineer, and a member of the academy. He died in 1910.

10. *The O. C. Marsh Fund*.—Professor Marsh, for twelve years president of the academy, died in 1899. He bequeathed the sum of \$10,000 to the academy, "the income to be used and expended by it for promoting original research in the natural sciences." This fund has not yet become available.

11. *The Alexander Agassiz Fund*.—Alexander Agassiz, who was president of the academy from 1901 to 1907, died in 1910, and bequeathed to the academy the sum of \$50,000 unconditionally. No decision has yet been reached in regard to the uses to which this fund is to be put.

12. *The Agassiz Medal*, which will be awarded for the first time this year, was provided for by a gift of Sir John Murray.

While this account may have proved tedious to some of you, it seemed necessary for the purpose of giving a correct impression of the work now being carried on. The academy has sacred duties to perform. It will soon devolve upon the younger members to see that these duties are conscientiously performed.

The constitution provides that the academy shall hold one meeting in each year in the city of Washington and another at such place and time as the council may determine. Whatever may be said of the duties of the academy as the scientific adviser of the government and as a custodian of trust

funds, it must be acknowledged that it is through the agency of its regular meetings that its influence is mainly exerted. In this as in other matters, it is the subtle, the intangible, the spiritual that tells. Workers in the field of science are supposed by some, perhaps by many, to be incapable of recognizing the force of the intangible, and yet scientific work must inevitably lead to this recognition. It is impossible to weigh and measure the effect of the meetings upon those who take part. But that effect is felt none the less, and it is certain that those who attend are in the long run benefited—some in one way, some in another. This is not a subject that lends itself to profitable discussion. It may not be out of place, however, for one who has been a regular attendant for over thirty years to make public acknowledgment of the debt which he personally owes the academy for the opportunities it has afforded him of associating with and counting among his friends those whose earnest, honest work has been an inspiration to him and to the world. This association has been an inestimable privilege for which he is deeply thankful.

The work of the academy will continue; new and younger members will take up the work. Is it too much to hope that when the centennial anniversary is celebrated some of the members here present may be remembered as we to-day remember with gratitude the founders?

IRA REMSEN

THE RELATION OF SCIENCE TO HIGHER EDUCATION IN AMERICA¹

THE half century which has elapsed since the founding of this academy has witnessed a radical change in the relations

¹ Address delivered before the National Academy of Sciences on the occasion of the semi-centennial celebration of its foundation.

between science and education. This change is equally marked in the professional training which prepares students for their several callings, and in the general training which prepares them for the duties and enjoyments of citizenship.

Fifty years ago the professional study of science in our universities was confined within very narrow limits—surprisingly narrow to those who see those places as they are to-day. There was no room for science in the schools of theology or of law. Schools of philosophy, in the modern sense of the word, had hardly developed. Even in schools of medicine, where the study of natural science in universities first gained a foothold, there was relatively little of scientific method, as we to-day understand the words, either in the teaching or in the study. There was much more learning of names of things than there now is, and much less learning of reasons of things; much more of tradition and much less of investigation. The anatomy and chemistry of the medical schools of those days were good sciences, as far as they went, but they generally did not go very far. As to the use made of science there is truth in the remark of one of my former colleagues that down to a recent day the three learned professions of theology, law and medicine had not advanced far beyond the old conception of the magic of the tribal medicine man, that the important thing for science to do was to find proper formulas of exorcism with which to banish evil spirits from their several realms of action.

Outside of the universities, a half century ago, things were little or no better. There was a small number of schools of engineering and a still smaller number of schools of chemical technology; but they did not form part of a large scheme of business training for the nation as a whole.

Most of the engineers had learned their profession in the field; most of the technologists had learned it in the shop.

All of this has changed during the fifty years of the life of the academy, and changed radically for the better. Our universities have developed scientific study in all their departments, and especially so in their schools of medicine and philosophy. Side by side with these university schools or faculties there have grown up colleges of engineering and technology, sometimes in connection with the university, sometimes outside of it, which lay a scientific foundation for many a calling that only a few years ago was thought to need no scientific foundation at all. The world has found a place for the scientific expert in every line, and is inclined to regard as the best school, not the one that has the most students, not even the one that can give the best general education, but that which in the different lines can train and furnish scientific experts of the highest rank and most varied knowledge.

For civilized nations have at last come to the conclusion that the old supposed antagonism between theory and practise was a misleading conception, and that the habit of drawing a sharp line between the theoretical man and the practical man was a pernicious one.

Fifty years ago a man who had obtained all his knowledge of his business by his own experience was habitually proud of the fact; he was, as the phrase went in those days, a self-made man who spent most of his time in worshipping his creator. He counted it a matter of superiority that he knew nothing except what he had found out himself and taught himself. To-day it is recognized that every practical man can learn much from the theorist; that there is room for the application of scientific principles in every department of life;

that the farmer, the manufacturer or the merchant, no less than the engineer or the physician, must prepare to avail himself of the theory which has been built up by investigators, which has been taught in laboratories and incorporated in books, if he would bring his practise up to the needs of the time.

Of all the conquests of modern science, there is none which, in my judgment, is more remarkable or significant than this conquest of current business opinion. We no longer draw a distinction between learned and unlearned professions. We have recognized that every profession and every trade, in order to be pursued to the best advantage, must be a learned one. None so complex as to be unable to get help from science; none so simple as not to need it. We have shaped our system of technical training accordingly; and we have learned to rate at their true worth the men and the places that can give training as research institutions, side by side with universities which make progress in such training possible.

Equally important, though of a different and perhaps less satisfactory character, has been the change in the scheme of our general education; in the choice of subjects and methods of teaching offered in preparation for the work of citizenship as distinguished from the preparation of each man for his business or calling.

The old course of study in our high schools and colleges consisted chiefly of classics, mathematics and metaphysics, with a little history and a few descriptive courses in natural science. Of scientific training in the modern sense it gave none, except to the unusual man whose mathematical tastes made the study of algebra and analytical geometry a means of scientific education in spite of text-book and instructor and class-room atmosphere, or

the still more unusual man who used his grammar and metaphysics as an exercise in closely ordered reasoning. The course, as a whole, was constructed for the student whose interests were in the past rather than in the present and the future. The training which it gave—good, in many respects—was a training in memory, in expression and in accuracy of apprehending language, one's own or another's, rather than in scientific method, as we understand it to-day.

There is on the facade of the main hall of a university which has done much for education in many lines, a representation of philosophy in a dominant central position—old-fashioned metaphysical philosophy—with the different sciences laying tribute at her feet. I suspect that this is not an unfair characterization of the views as to the place of science in education which prevailed among most college faculties a generation or two ago.

Now let me say right here that I do not for a moment overlook the advantages of the old system. It taught the boys to use books and find things out from books, and to expect to do hard work for that purpose instead of to have somebody else make it easy. This was a great merit, and the boys trained under the old system showed this merit. But college faculties were often blind to the particular kind of book learning that was most significant for human progress and which was of most concern to the living world outside.

For at the time when the academy was founded, and in the time since, chemistry and physics and geology and biology were becoming not only matters of importance to the experts in their several callings, as I have indicated, but subjects of real and dominant interest to intelligent men who were not experts, but who cared for knowledge and who cared for current history.

A large section of the world, an increasingly large section of the world, cared more for books that explained the tendencies of the present than for those that embodied the ideals of the past. Perhaps this movement may have gone too far and may have caused people to care too little for the ideals of the past, to overvalue scientific reading as compared with historical or literary reading. I shall not try to discuss whether it did or not. At any rate, a curriculum which was exclusively occupied with classics and philosophy ceased to meet the demands of grown men or the needs of boys, and the course of study in our colleges had to be remodelled accordingly. Each decade of the last fifty years has witnessed a gradual crowding out of classics from our older schools and colleges by subjects of new and more present interest, and a growth of new schools and colleges of a different kind, where science in varying forms is made the chief subject of attention and other matters relegated more or less to the background.

Now this increasing interest in science is a matter about which we all, members of the academy and guests of the academy, scientific men and literary men, may rejoice heartily. But how far the things that are called science always deserve the name of science, or how far the teaching of such subjects by present methods always deserves the name of education, is quite another question. Every school superintendent likes to stimulate the attention of his pupils by giving them the opportunity to see amusing phenomena with their own eyes, and if possible set them in motion with their own hands. Under some circumstances this may be the best kind of scientific training; under other circumstances it may be no training at all.

Nature study—to quote a phrase which is popular among educators of the present

time—is good if it is made the basis for teaching scientific methods, and bad if it is simply made a means of momentary amusement. Unfortunately, a large part of our school committees and school teachers think that the subject makes the science. They may not go as far as the author of “Murray’s Handbook to Spain,” who says that the mountains of that country, to quote his own words, “abound in botany and zoology.” But they are apt to assume that the picking to pieces of flowers is in itself botany, and that hearing a carbon disulphide mixture make a loud explosion marks progress in chemistry, and to act accordingly. A short time ago a school superintendent in one of our more newly developed parts of the country said he had to make a change because it was so easy to find thoroughly competent teachers of physics, but that so few of them ever knew any algebra.

Fifty years ago the members of the National Academy of Sciences who held seats in college faculties were occupied in protecting science against its enemies. I am not sure but what to-day their chief duty lies in protecting it against its friends. When the National Educational Association says that high schools should be allowed to omit the study of algebra and geometry and that the colleges should be compelled to accept for admission an equivalent amount of “science”—God save the mark!—it is time for the true friends of science to call a halt.

For the importance of scientific training to the student in our high schools and colleges is not due primarily, or in large measure, to the facts of physics or biology that he learns in the school. It is due to the training in certain habits of observation and deduction, in certain methods of hypothesis and verification, which he can get more effectively by a good course in science

than by one predominantly devoted to languages, where the scientific training is merely incidental. That the facts of physics or biology are more interesting to the student and to the world than those of Latin and Greek and have more obvious bearing on everyday life is a help to the teacher in securing the voluntary cooperation of the pupil; but it is far from being the fundamental reason why the subjects themselves are educationally valuable. It is not the subject that makes the course scientific; it is the method.

You have been good enough, Mr. President, to refer to my father's connection with the academy, and I for my part am glad to take the opportunity to say that he regarded his election to membership in this body as the greatest honor he ever received. I feel sure, therefore, that I shall be pardoned if I illustrate the point I have just made by reference to my father's teaching.

Fifty years ago the one course in the academic department of Yale College where modern science was really taught, was the course in freshman Greek. For my father, though he had the highest enjoyment of classical literature, was by training and temperament a philologist; and he taught the freshmen who came under him to take Greek verbs to pieces and compare and observe their parts and put them together again, and see what principles were involved in the analysis and synthesis, exactly as the botanist might have done with his plants or the chemist with his elements.

In those days chemistry and physics were taught in Yale College, as distinct from the Sheffield Scientific School, solely by text-books and lectures. Philology was taught by the laboratory method; and for that reason the freshman Greek course was a course in modern science and meant that to the pupils. The courses in chemistry

and physics widened the boy's knowledge of facts and doubtless encouraged many of them to get scientific training for themselves afterward; but the course in freshman Greek was a course in science, because the boys learned to do the things, both easy and hard, which are the heritage of the man of science.

Science is not a department of life which may be partitioned off from other parts; it is not the knowledge of certain kinds of facts and the observation of certain kinds of interest, as distinct from other facts and other interests; it is a way of looking at life and dealing with life; a way of finding out facts of every kind and dealing with interests as varied as the world itself,

Where each for the joy of the working, and each
in his separate star,
Shall draw the thing as he sees it, for the God of
things as they are.

ARTHUR T. HADLEY

YALE UNIVERSITY

*SPEECHES AT THE ANNIVERSARY DINNER
OF THE NATIONAL ACADEMY
OF SCIENCES*

SPEECH OF THE RIGHT HONORABLE JAMES
BRYCE

Doctor Woodward, President Remsen and gentlemen: I am very much touched by the kind words in which my old friend, Dr. Woodward, has introduced me to you, and I am more than grateful to you for the way in which you are kind enough to receive me. It does make one happy to be so received and to be assured that one has not lived in this country six years without having acquired some friendliness on the part of its people.

But, apart from that, gentlemen, I stand before you this evening as a rather unhappy man, because it is the last evening on which I am likely to have the privilege—at any rate, in an official capacity—of