who are adequately qualified for service in chemistry are designated as chemists, thus safeguarding the public against the quack and shyster chemists who are not only responsible for great economic losses but who are also instrumental in holding down the status of the profession of chemistry and of creating a false impression in the minds of the public as to the work of the chemist.

We have faith in the idea that the reputation of the profession of chemistry can be established by this means better than by any legislative action. We do not believe that genuine service can be guaranteed by legislating to prevent charlatans from pretending to be chemists.

We have provided a means for the appropriate recognition of the distinguished service rendered by individual members of the profession in the form of three medals to be awarded in the fields of governmental institutions, educational institutions and industry.

By "governmental" we mean to include federal and state laboratories and public research laboratories, such as the Rockefeller Institute and Mellon Institute.

Under "educational" we include all research institutions in which the prime aim is pure research. The institute proposes to seek the cooperation of the colleges, universities and technical schools in providing adequate and definite training for the profession of chemistry. While there are many of the schools giving adequate courses of training there are still too large a proportion of men being graduated with inadequate training. There is no differentiation between men who have had only a few courses in elementary chemistry and those who have specialized and done graduate work. We propose to eliminate this condition and try to get recognized the fundamental principle that the profession of chemistry requires certain fundamental training irrespective of specialized departments in which that training is later employed. We also wish to lend our aid in emphasizing the necessity for broad basic training for the profession of chemistry. To this end we propose to suggest that the course shall include sufficient English to enable the chemist to express himself with brevity, clarity, and force, sufficient foreign languages to facilitate keeping in touch with chemical progress in foreign countries, history enough to enable a chemist to understand the conditions of the present and anticipate demands of the future by a comparison of the observations he makes with the record of the past; a basic training in mathematics and physics sufficient to enable the chemist to apply the fundamental principles of chemistry to the solution of engineering problems, sufficient training in the fundamentals of philosophy, psychology, social science and economics to orientate the chemist in his business relationships and to guarantee for him a place in the constructive element of society.

The institute is pledged to a policy of cooperation with all other societies and institutions serving chemistry as a science and as a profession.

M. L. CROSSLEY

BOUND BROOK, N. J.

THE TRAINING OF MEN FOR THE PROFESSION OF CHEMISTRY[1]

Every one owes some of his time to the upbuilding of the profession to which he belongs.—*Theodore Roosevelt.*

IF it lie in my power to make the short address of this evening of any real service to you who hear it, I do not know what I could bring to your attention of greater importance at this time than the need of more attention, on the part of our institute, to some of the present-day problems of chemistry education. We can not as an organization be indifferent to the various interests of our science. Our interests are the universities' interests and also the public interests, and we have a work of our own to do; and being engaged in a labor of science we owe a debt to our educational institutions, and consequently should be prepared to respond to their call for help and advice in their educational work. I feel quite certain that the men who are in active service in the teaching profession and in academic research activities do not disparage to-day the investigations done in industry, and do not put a low value upon industrial work and take a narrow viewpoint of chemical studies carried on successfully outside of the academic atmosphere. We are all working for the accomplishment of a definite object, and the closer we can cooperate in our various problems the more easily and quickly will we achieve the final results for which we all are striving.

After a teaching experience of twenty-five years in an American university which has always played an important part educationally in the promotion and development of the pure and applied sciences, I feel that there is no subject that I am better qualified to speak about to you to-night and which is of more importance to our own profession than that dealing with the problem of training young men for actual service in the field of chemistry. While it is a function of our institute to help in every way that it can the status of the profession of chemistry, we must also ever keep in mind the fact that the first prerequisite for professional success is a thorough fundamental training in those subjects which meet best the needs of

[1] Presidential address delivered before the American Institute of Chemists at their annual meeting held in Rumford Hall in the Chemists' Club, New York City, May 8, 1926.

the chemist. It behooves us as an organization, therefore, to assist our academic teachers in every way that we can in the accomplishment of the difficult educational task which is entrusted to them.

In his presidential address delivered at the third meeting of our institute held in Baltimore, Maryland, in 1925, dealing with the subject, "The American Institute of Chemists, Its Scope and Methods," my predecessor in office wrote as follows:

> This is the formative period in our history. To-day we are concerned chiefly with the formation and development of the machinery of organization. Our future growth will depend upon the structure we create now. This is a very serious undertaking. We can not afford to make many mistakes. Progress is slow at best and we must not be discouraged, if in the face of difficulties and disappointments, we find it necessary to advance cautiously. It is our privilege to serve as members of a very important profession and we are, therefore, obligated to improve the status of this profession. We must establish the means of differentiating between the trained and competent on one hand, and the untrained and incompetent on the other. The public can not differentiate between the qualified chemist and the unqualified, and as a result both are often discredited. It is a function of this institute to say who is a chemist and what constitutes an adequate training for the profession of chemistry.

During the month of September of this year we shall celebrate in the City of Philadelphia the fiftieth anniversary of the organization of the American Chemical Society. In the collection of historical and statistical data which will serve to reveal to the public the progress of this society, I have had the opportunity of making a survey of certain developments which have influenced the growth of this society and which also have an important bearing on the subject which I have chosen for my discussion to-night. Certain facts have been revealed as a result of this research which I believe are of sufficient interest to bring to the attention of this institute. I feel quite confident that the aims and the methods of our organization will be advanced and its function better understood when it is made clear to our academic institutions that we have no selfish purpose, but are interested in aiding them in the solution of some of their present-day educational problems.

In a discussion of the progress of chemistry in this country since the year 1876 it would be impossible to present any survey or a constructive review of what has been accomplished in our field of science without reference to the teaching side, showing the remarkable advance made in educational work and methods. Our institutions of higher learning deserve especial consideration, as they have been the most powerful stimulus to the general activity in science of the entire United States and have been the means of awakening the public mind to the importance of a study of chemical science, giving the same a rank in the general estimate never before attained. We recognize the fact to-day that the acquisition of a knowledge of chemistry and the part it plays in the promotion of human welfare is necessary for the proper rounding out of a cultural education. In fact, on every hand has the educated mind of America been directed toward all departments of scientific study. Chemistry is recognized to-day as a factor of major influence in our everyday life, an agent of power influencing and directing the growth and prosperity of our country.

Preceding the time of organization of the American Chemical Society, there was practically no opportunity offered for American students to acquire a special training in chemistry in American universities. To get an education in this science one was compelled to seek the European university laboratory, and the majority of those who were fortunate enough to enjoy this privilege went to Germany. In fact, if we go back to the year 1853 we find that there were only four laboratories in America that were available at that time for the study of chemistry, namely, the chemistry laboratory at Yale, the Amherst College laboratory, a private laboratory in the city of Philadelphia and the laboratory at the Lawrence Scientific School at Harvard. Professor Chandler writes in one of his lectures that, when he was in Göttingen, Germany, in 1855–6, working in Professor Wöhler's laboratory, thirty students were registered in research in chemistry, of which thirteen were Americans. Even as late as 1876 we maintained no systematic courses of study in chemistry. Students who desired to pursue advanced work in this science were obliged to go abroad. Teaching was chiefly by the didactic method and consequently it is not surprising that little progress was made for several years. It was not a question, however, of there being no great teachers in our country in those early days, as there were several men who stood out very prominently at that time, of whom may be mentioned Elliot, Remsen, Chandler, Morley and Mallet. These distinguished pioneers, who piloted the course of the ship in these early days, are deserving of all the praise and reward that we can give them. The names of any one of them would well grace the rôle of honorary membership in our institute. The majority of the chemists who have attained prominence in their profession can generally point to one of their teachers as the original bearer of the torch which gave him light and inspiration leading to his future success in life. There is no pleasure more gratifying to a teacher for the service that he renders than the experience of living to see some of his students attain success in their profes-

sional career and to feel that he played an important part in their accomplishments. The remark is very often heard to-day that college professors, who used to make most of the discoveries in science, are now being hard run by the scientists in the laboratories of industrial organizations. While this statement is very probably true in some degree, I am not ready to admit that we have reached that stage where our professors must abdicate entirely in favor of their industrial comrades. The greatest accomplishment of all research is the discovery of the young genius who gives promise of developing into an original investigator. In this service we shall always need inspiring teachers and when such men are found in our colleges I have no fear that they will need to abdicate in favor of their industrial brethren.

To-day we have more universities than any other country in the world, we have a larger number of technical schools of the very highest order and innumerable colleges, all of which are offering advanced instruction in the various branches of chemistry. Some of the very finest chemical laboratories and experimental equipment in the world are maintained by these institutions. Every state in the Union has its tax-supported university and agricultural experiment station and their respective laboratories. There is abundant provision for advanced educational work in all the branches of chemistry, and there is every indication that the chemistry staffs in our major institutions realize fully the meaning of the mission they have to perform, in order to turn out the type of product that is expected of them. In other words, we have grown from very small beginnings in fifty years to a position of prominence in the field of chemical education.

These educational institutions are to-day regarded as they have been in the past as the most fitting places for the making of our young investigators in chemistry. Many of them can lay claim to a very high rank in our system of instruction and are contributing in full share to the world's acquisition of new knowledge. This condition did not prevail, however, until in very recent years, when our universities and colleges introduced their modern system of graduate instruction. Formerly we were charged with not contributing our full share year by year, but this could not be justly charged to the teachers operating in those institutions. This condition was due to the fact that those who were competent to do research were unable to do it, because they had no time for it, as they were compelled to devote the major proportion of their time for teaching work or in the performance of administrative duties. This condition was revealed in an emphatic manner in an address delivered at the inaugural exercises of Professor William A. Noyes when he was made head of the chemical laboratory of the University of Illinois on October 18, 1907. He wrote as follows:

> With the older men there are scarcely 20 men in all, directing strictly original research work in our American universities, work involving new ideas, as well as the preparation of new compounds. The supply is far too small to meet the demand, and in view of the importance of the subject, this condition, unless improved, presents a distinct menace to our educational and economic development. A second significant fact is that with the exception of two or three men working under particularly favorable conditions, the productiveness of our research men is by no means commensurate with the output of an equal number of men of Germany. An impartial scrutiny of the situation shows unmistakably serious defects in our American conditions which must be removed if chemical research is to flourish here as abroad, and if able men are to be attracted in sufficient numbers to a life devoted to research and research instruction.
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> Unless we secure conditions for a large measure of success and productiveness, chemical research in our universities will never attract our best Americans in sufficient numbers to satisfy the minimum demand of our country for able investigators in academic and industrial lines.

Fortunately this condition of affairs has been improved, and it is recognized to-day that no educational institution is worthy of being called a university or a college of high rank which does not provide and encourage the very best opportunity for advanced research. Nowhere in the world has there been such a rapid development educationally in the fields of pure and applied science as in our state universities of the west. There is not one of these progressive institutions to-day which is not doing productive research work in the different branches of chemistry, as well as assisting and contributing to the industrial development of the respective state from which it receives support by taxation. In his paper on "Discovery of Truth in Universities" W. D. Scott[1] has written as follows:

> Archimedes said that if he were only provided with a fulcrum, he could move the earth. The American universities are supplying an effective agency for the discovery of truth, and are thus providing the fulcrum that makes it possible to move the earth and to promote the welfare of all.

As regards originality in the promotion of chemical research and in the application of chemistry to practice we in America hold to-day a most brilliant record. In the early period of our industrial development our record in these respects was given to other countries,

[1] *Century, 108*, N. S. 556 (1924).

who reaped a harvest which should have been ours. It is undoubtedly due in a very large degree to the growth of our modern American graduate schools and the stimulus that has been given to research activities in these institutions that the tables have finally been reversed. To-day just as good opportunities are given in American universities for advanced research in all branches of chemistry as can be found in foreign laboratories. A certification of proficiency in chemistry received from an American university of recognized standing is just as valuable to-day as one received from a foreign university. In our advance we are gaining strength and contributing to the world's knowledge. We find scientists in both our academic and industrial institutions, and in the words of W. H. Perkin, "There is no chasm between pure and applied science, they do not even stand side by side but are linked together."

Great investigators in chemistry, like great men in anything else, are born not made, but when they are born it is necessary that they be trained and the place for their training in chemistry is the university or technical school. Let us as an institute see to it that the officers in charge of the various chemistry departments of these training schools and their teachers are properly instructed and informed of the requirements of our profession.

TREAT B. JOHNSON

YALE UNIVERSITY

SCIENCE FOR HUMANITY'S SAKE[1]

INSTEAD of attempting on this occasion to review research work which is in a limited field, of interest to but few chemists, to whom it is readily accessible, I will endeavor to visualize and depict an ideal, which, like all worthwhile goals, is at times dim and distant, but not the less inspiring.

In "Sermons of a Chemist," that fascinating and stimulating book by Edwin E. Slosson, he has suggested that just as every quadratic equation has two roots, so every question in nature has two parts, "how" and "why" does nature accomplish certain things; and of these questions science is able to answer only the first. If now we inquire regarding the work of the scientist himself, we may properly ask "How does he work?" and "Why does he work?" The annals of science consist chiefly of the answer to the first question, but only occasionally do we find the second question even mentioned, much less discussed. Surely with the greatly increased interest in science during recent decades and the present efforts to further stimulate scientific research, it is not unreasonable to ask: "Why this feverish anxiety to spend money and effort in scientific pursuits?"

In this attempt to point out some of the possible answers to this question, the illustrations will be taken largely from the field of chemistry, because the speaker and the audience are chiefly concerned with that field. It might therefore seem that the title is too comprehensive. In this day and age, however, when the border line between physics and chemistry has ceased to exist and when chemistry plays so important a part in biology and geology, it is safe to assume that much the same factors are involved in the pursuit of chemistry and of the other natural sciences and that the participants are influenced by the same motives.

No doubt the title will at once suggest to you the great service rendered by science to mankind in the prevention and cure of disease and the alleviation of pain; and the industrial chemist may dismiss the subject as having only passing interest for him. For those scientists who have expended their time, means, strength, and even their lives, in the fight against disease, too much praise can not be given. But there is a need also for high ideals and heroic service among those whose work in science deals with more prosaic subjects, such as "shoes and ships and sealing wax." The proverb is as true now as it ever was that "where there is no vision, the people perish."

Some, especially those engaged in "pure science," may resent the suggestion that there need be any reason given for scientific research, and may glibly quote "science for science's sake," or urge that the joy of the work is sufficient justification; or if they fear the appearance of affectation will say that they work just for the fun they get out of it. Beyond a doubt, the joy of discovery is one of the most potent motives of the scientist, and insofar as this attitude stimulates and encourages research in those fundamental fields of science upon which all sound applications must rest, it is indeed commendable. If, however, such an attitude induces indifference toward or even disdain for the application of the results of such researches to meet the needs of humanity, it creates a false distinction and not infrequently cuts off both the moral and the financial support that are essential to the conduct or success of exhaustive and fundamental research. Recognition of this fact is no doubt responsible for the frequency with which those interested and engaged in fundamental studies, which they urge "for science's sake," hasten to assure the public (or Congress) that "besides, one can never be sure but that the most abstract research may lead to results of definite industrial or economic value." If one is to weigh the earth, he feels called upon to explain that the results may aid in the detection of oil-

[1] Address given upon receiving the American Institute of Chemists' Medal in New York, May 8, 1926.