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HOW CHEMISTRY IS BEST TAUGHT.*

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THE subject "How chemistry is best taught," which has been proposed to us for discussion, has a serious interest for all persons who are engaged in teaching chemistry, and it is of especial importance to those of us who have in charge the preparation of young men for professional employment. In view of the prominence of scientific subjects and methods in the present systems of education, it is incumbent upon the adherents of these methods to demonstrate by their results that they are not in error in assuming that science should have an equivalent place with other departments of knowledge. In the higher institutions this question has received a definite answer; in the secondary schools evidently much has yet to be accomplished in the direction of general education as well as in the preparation for higher study.

That the importance of a knowledge of elementary chemistry is apparent to all who are capable of appreciating its usefulness, is evident in the recent extension of instruction in the secondary schools. In the larger portion of our high schools, however, physical science still occupies a subordinate place, or it is taught merely from text-books with little, if any, laboratory training. Probably the chief hindrance to any radical change is a lack of appreciation on the part of the public. If parents could be brought to see that their sons and daughters would receive a better education if physical science properly taught formed an essential feature of the high school course, the change would not be long delayed. That the training of many teachers is scarcely more comprehensive than they are called upon to impart is of less importance, since at present those who are educated in the higher institutions have better opportunities, and those who are deficient can improve their knowledge in special courses for teachers. Doubtless the many popular movements of the present day will exert a beneficial influence in extending an acquaintance with the application of scientific principles. Such unique and instructive object lessons as that which has been designed, under the direction of Prof. Ellen H. Richards, for the Rumford kitchen, in the Columbian Exposition, cannot fail to attract public attention. It requires no particular training in observation to recognize the difference in nutrition of foods which have a widely different nutritive value; but when an appetite whetted to the sharpest edge in an endeavor to see all the exhibits in the Liberal Arts building in one visit, and the unavailing efforts to extract a crumb of comfort from the places so improperly named, is brought in contact with the wholesome dishes prepared in the Rumford kitchen, and their satisfying influence, the numbers representing the food values will be in a favorable connection to awaken a desire for further information. The same principle is applied in a different manner in the exhibits from the agricultural stations which explain the composition of dairy products, of animal foods and the methods of chemical investigations. These exhibits have a particular interest for persons engaged in agricultural pursuits since they are a part of the well-directed efforts of the stations in disseminating knowledge. Probably in no department of education has there been a more substantial growth during the last twenty years than on the part of intelligent farmers in applying the practical information coming to them from the results of investigations carried on at the experiment stations. These illustrations may seem somewhat removed from the main question before us, but I am convinced that the efficiency of higher instruction in chemistry will be greatly improved when students coming to us from the secondary schools shall have had the advantage of practical training in elementary physical science, and I believe this will be the sooner accomplished through a recognition of its benefits in the affairs of every-day life.

I think we shall all agree that the best argument to be urged in favor of a prominent place for chemistry in any grade of instruction is the value of experimental methods for the development of mental power. This feature should naturally appear with especial prominence in courses leading to the degree of Bachelor of Arts; and if the schools of science are to be maintained on a higher plane than the trade schools or shops, the courses of study must be conducted with reference to the attainment of mental discipline and scholarship. In the courses in chemistry I am unable to see why this should interfere with the acquisition of practical knowledge.

The guiding star to successful teaching in chemistry is the personality and enthusiasm of the instructor. With the great increase in attendance in many institutions the earlier relations between student and instructor, which were frequently mingled with deep personal feeling, somewhat akin to veneration on the part of the student, are well-nigh impossible. Nevertheless, an enthusiastic teacher with tact and good judgment has little difficulty in maintaining a profound interest even in large classes. In successful teaching we all know how much depends upon the attitude of the instructor toward his students. Courteous relations, with a clear understanding that teacher and students are mutually interested in the acquisition of knowledge, readily secure the confidence and esteem of a body of students, and the instruction need seldom be interrupted by questions of conduct. A faithful teacher does not limit his attention to the brighter minds; students slow in comprehension but earnest in application secure a store of information which will be used later to the best advantage. It was a wise teacher who said: "I am faithful in my duty to dull students; in my old age I may need favors of the men of wealth."

In assimilating their methods from European laboratories, the chemists of the United States, untrammelled by traditions and unrestrained by the influence of any particular school, have been in favorable conditions to appreciate the labors of the great masters of other countries. Unfortunately, it may be, in the wonderful development of our natural resources, the temptation to enjoy material benefits may have retarded the growth of orig-

*A paper read before the section of Didactic Chemistry in the World's Congress Auxiliary of the World's Columbian Exposition at Chicago, August 26, 1893.