THE QUALIFICATIONS OF CHEMISTRY TEACHERS IN SECONDARY SCHOOLS*

WILHELM SEGERBLOM, PHILLIPS EXETER ACADEMY, EXETER, NEW HAMPSHIRE

The growing importance of chemistry in industry and culture necessitates the best instruction possible in the schools. The secondary-school teacher of chemistry needs a certain amount of specialized knowledge and training. A certain amount of mathematics and other sciences is desirable. Some knowledge of teaching methods is also desirable. Certain qualities that are looked for in students should find their highest expression in the teacher.

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I shall use considerably less than the forty minutes allotted to me to speak on the qualifications of chemistry teachers in secondary schools, not because this aspect of the question of teacher qualifications is less important than those aspects which the following speakers are to discuss, but because the whole situation can be expressed in one short sentence.

That person is best qualified to teach high-school chemistry who has; (1) a love for the subject itself, (2) a love for pupils, and (3) a love for the job of transferring the subject to the pupil.

That, to my mind, expresses, in a nutshell, my contribution to this symposium, but of course you will immediately be reading into these three phases of the question certain very important details. It is those details which we might profitably consider for a few moments.

First, love of the subject itself implies a thorough knowledge of so much of the subject as is necessary to do one's work effectively.

Those of us who are old enough to remember how little chemistry we needed to teach our pupils thirty to thirty-five years ago to fit them to pass

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the entrance examinations for college will realize easily to what extent the entrance requirements have been increased during this period. It is evident therefore that the subject-content qualification of the chemistry teacher of today is of considerable importance.

That the knowledge of subject-content is not likely to be reduced any in the future is evident, (1) from the possibly greater interest of modern youth in things scientific, (2) from the opportunities afforded by the student science clubs of today, (3) from the increasing reluctance on the part of the student to accept statements simply because "the teacher says so," and (4) from the recent increase in printed scientific matter of a popular nature for the lay reader.

It would seem therefore that the chemistry teacher should have had, as a minimum, college courses in general inorganic chemistry, organic chemistry, qualitative analysis, quantitative analysis, and physical chemistry, the first because of the basic principles and general information involved, the organic because of the important rôle organic substances play in the life of today, the two analytical courses because of the practice in laboratory technic they give, and the last because of the increasing work on the border line between chemistry and physics.

The foregoing is the speaker's personal opinion but it corresponds closely, though not exactly, with the findings of the Division's Committee on Preparation of High-School Chemistry Teachers (*1*) of which a later speaker in this symposium, Dr. A. J. Currier, is chairman; it agrees similarly with the Preliminary Report of the Committee on Education of the American Institute of Chemists (*2*) and with a number of individual and committee pronouncements.

I have in mind the teacher who is fortunate enough to teach chemistry only. In that case he would do well to have as a background those other undergraduate courses in chemistry which are ordinarily given in college, in order to give him added chemical background. Mathematics should have been pursued through analytical geometry. Of course, English should have been pursued each year up to graduation from college with special emphasis on ability to express one's self in clear and correct manner. Ability to read scientific French and German is still a desirable, and occasionally a necessary, accomplishment. A course or two on methods of teaching and on education are desirable, usually helpful, and often required by law for teaching in a public school system. If there is room and time for any "remaining subjects" the prospective teacher should certainly be given opportunity to choose such as appeal to him (or her).

All the foregoing applies to the person for whom chemistry is to be the only subject on his (or her) teaching schedule. How about the high-school teacher who must teach other subjects in addition, for unfortunately there are still "some such" in the United States?

E. W. Phelan (*3*) in his article on "The Status of Chemistry and the Chemistry Teacher in the Ohio High Schools" points out that in from two-thirds to three-quarters of the county and city high schools investigated, chemistry teachers had to teach one, two, or three "other subjects"; and in some cases as many as five or six other subjects. Now, let us not for a moment assume that Ohio is the only state in which such conditions exist, for the evidence is to the contrary.

What is the solution? *Theoretically*, the prospective teacher should specialize in college just the same in proportion on these "other subjects" as it was just indicated he should specialize on chemistry, but *practically*—well, that is another question. He simply does not "qualify," and we hear and read of what A. M. VandeVoort (*4*) in her article on the normal school and teachers' college situation calls "the inadequacy of the preparation of teachers."

When G. Zeismer (*5*) says that "forty per cent of the (science) teachers (in Wisconsin) have not majored in science and, obviously, are not prepared, or very meagerly prepared at best, to teach the science subjects," we hesitate to lay the blame on the teachers.

Dr. J. E. Mills (*6*) has pointed out that "in some states a student who has satisfactorily specialized in chemistry at his state university, following exactly the course recommended by the institution, and who has received the degree of bachelor of science in chemistry, is not allowed to teach chemistry in any accredited high school of his state." The trouble seems to be that the number of semester hours of educational work required for a teacher's certificate precludes sufficient time devoted to the subject specialized in. Obviously, if a properly "qualified" teacher of chemistry is desired he should be given opportunity to qualify himself properly.

Our second qualification—a love for pupils—seems perhaps less definite than the love for the subject itself but it is none the less important.

Some one has said that *students* should be: interested, reliable, neat, accurate, careful, conscientious, thorough, serious, punctual, studious, honest, ambitious, polite, diligent, willing to work, inquisitive, enthusiastic, investigative, and able to follow directions.

Why should we not add to this that the chemistry *teacher* should also have these same qualifications?

It is a truism that children are imitators. So are we older children for that matter. How can the teacher, who has the pupil's interest at heart, better inculcate the desirable qualities just mentioned than by being a living example of them himself (or herself)?

Such "living example" instruction is well illustrated by: (1) carefulness and skill in the manipulation of apparatus, (2) accuracy in taking measurements, (3) system, order, and neatness in the arrangement of apparatus, and many similar procedures which readily occur to one.

For the teacher to manifest the above qualities, certain qualities of a less chemical nature are helpful, namely, character above reproach, pleasing personality, good health, respect for law and religion, etc., and these should not be neglected.

The third qualification—love for the job of transferring the subject to the pupil—is so closely associated with love for the pupils that many of the things just mentioned apply here also.

From the title one thinks first of courses in education as the best source of help. J. O. Frank (*7*) says:

> Since chemistry teachers have to teach in high school, it is obvious that they must thoroughly understand teaching at the high-school level and especially the teaching of high-school science. We must provide for not only an understanding of secondary education, but also technic in teaching.

On the other hand, Brownell and Wade (*8*) say:

> It is very likely that theory and methods courses in education have been so divorced from whatever subject matter is to be taught as to become mere abstractions, and in many cases but a shibboleth of the vocabulary of education, lacking in vital relationship and significance.

How shall it be determined whether a teacher has the desired qualifications? Let us cull our answer from a recent article by F. C. Coulson (*9*) of the Roosevelt High School, Chicago. Among other things, it says:

> The chief aims of elementary chemistry should be: (1) to give the pupils an idea of the importance and significance of chemistry in our national life, (2) to give information of definite service to home and daily life, (3) to develop specific interests, habits, and abilities which should be contributed by all sciences, (4) to secure an element of continuity in science by knitting together previous science work through recall and through the presentation of principles—new ones and elaboration on old ones, and (5) to help the student discover whether he has an aptitude for further work in pure or applied science and to induce such pupils to continue science studies in the university or technical school.

If the teacher is achieving these results, why ask if he (or she) has the requisite "qualifications"? College admission committees and college chemistry teachers may measure the high-school teacher's qualifications by the results of set examinations or by the student's ability to continue the study of chemistry in college. State and community boards of education may have their own criteria of the qualifications necessary to teach chemistry successfully, but a consideration of these may be a little beside the question at present. In the last analysis, is not the teacher himself (or herself) the best judge? The teacher who has the three loves mentioned at the beginning of these remarks, and whose vision and effort is constantly forward and upward certainly knows instinctively whether the qualifications are present or absent.

That this subject of qualifications is timely and important today is evidenced by a number of facts: (1) the presence of this symposium on our program, (2) the activity of the numerous committees of our Division bearing on the problems of the teacher, (3) the three-year survey of public-school teacher training recently initiated by the Office of Education of the Department of Interior to make a study of the qualifications of teachers in the public schools, the supply of available teachers, the facilities available and needed for teacher training, including courses of study and methods of teaching, (4) the work of the Committee on Professional Training appointed by the Central Association of Science and Mathematics Teachers, especially their recommendation that "courses offered in the teaching of high-school subjects or in practice teaching be taught or supervised by instructors who have been trained in subject matter as well as in methods of teaching" (*10*), to say nothing (5) of the many individual investigations bearing on this subject as evidenced by numerous articles in the printed publications which reach the teacher's desk.

Is there any solution to the questions arising out of the consideration of the qualifications of high-school chemistry teachers? We should be untrue to the trust imposed on us by our association with this Division of Chemical Education if we were other than optimistic for the future solution of these questions.

As some of the steps in the right direction we might mention: (1) a greater and constant effort on the part of the teacher to perfect himself (or herself) in the knowledge of chemistry and other directly associated tools of the job, (2) sharing our successes and problems with others through joining an association of chemistry teachers, (3) getting school principals and boards of education to recognize the difference between instruction in chemistry and that in other subjects to the extent of providing the chemistry teacher with the proper conditions under which to work, and (4) then finally measuring up to the enlarged opportunities.

Finally, let me close as I began: That person is best qualified to teach high-school chemistry who has: (1) a love for the subject itself, (2) a love for pupils, and (3) a love for the job of transferring the subject to the pupil.

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