

THE RATIO OF QUANTITATIVE TO QUALITATIVE  
EXPERIMENTS IN CHEMISTRY.\*

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The introduction of quantitative experimentation into courses of laboratory practice in general or inorganic chemistry may be justified on at least three grounds—first, because work of this character serves to demonstrate the advantage of care and neatness in manipulation and in the keeping of laboratory records; second, because through such work the principles taught in the classroom, which are only too likely to become abstract and often vague notions, tend to take a concrete form in the mind of the pupil, as, for example, the law of definite proportions, which is easily demonstrated by simple experimentation, within the capacity of the beginner; and, third, because the results of quantitative work furnish a basis for comparison and discussion which tends to stimulate community of interest among the pupils, and permit each to measure his own attainment by the work of his neighbor, or the class as a whole.

On the other hand it will be conceded that quantitative work demands, for success, more constant attention to the individual on the part of the teacher; that it consumes more of the time of the pupil, and so restricts the range of experimentation; and that the “quantitative sense” in chemistry is not always readily acquired. In physics, the quantitative measurements are a refining of observations made with measures of length, capacity and weight already essentially familiar to the pupil, while in chemical manipulation quantitative accuracy depends upon the avoidance of a loss or gain of material which is not so easily appreciated by the beginner in connection with unfamiliar procedures and novel forms of apparatus.

A secondary school course of instruction in chemistry should, in the speaker’s opinion, be primarily designed to give the

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pupil as wide a knowledge of the facts of the science as is compatible with reasonable thoroughness. It should not avoid the simpler fundamental principles and laws, nor should it, on the other hand, include much chemical theory; it should be serviceable alike for the pupil who will pursue the subject in college and for his less fortunate companion. How, in such a course, the ratio between qualitative (descriptive) experimentation and quantitative work shall be chosen can hardly be set down in general terms. The fortunate teacher with small classes and good equipment will doubtless find it helpful and expedient to include a considerable number of exact experiments in his course, while the overtaxed instructor will meet with a larger measure of success from qualitative work. It should always be borne in mind that a considerable proportion of the instruction will necessarily be of the qualitative sort, and that work of this character is in no way inferior to quantitative work in its demands for painstaking instruction, even though the necessity for constant attention to the pupil may be less. Similar consideration with respect to the time devoted to the subject in a particular school will often be a determining factor.

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## A MODIFIED DEMONSTRATION PRESSURE GAUGE.

BY EDWIN H. HALL,

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The following drawings illustrate certain improvements in the construction and use of the demonstration pressure gauge which commonly bears my name. The general features of the instrument I need not dwell on, as they have been known to teachers for many years. Some of the changes to be pointed out are of my own devising, while others are not.