

## SEMIMICRO METHODS IN THE TEACHING OF CHEMISTRY

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The introduction of methods and technics permitting chemical experimentation with very small amounts was introduced about the first decade of the present century. The earliest uses of micro methods appears in biochemical and mineralogical investigations. In the detection of poisons it became necessary to develop tests using small amounts of materials and having high sensitivity. Also, as early as 1894, micro methods had been developed for the identification of a large number of minerals using in many cases a single crystal or 1 mg. of a substance were described. (1903.) The first microbalances were developed between 1909-1911. The work of Emich and Pregl during the early part of the century in the development of micro-chemical methods in quantitative organic analysis may be regarded as the beginning of a systematic growth in micro and semi-micro methods in chemical experimentation.

It was clearly recognized that the micro methods saved time and material, without sacrificing accuracy, provided the proper technics were used. Between 1925-1935, a few universities in this country introduced courses in micro-chemical quantitative organic analysis. One of the first introductions of the micro methods to undergraduate instruction was by E. C. Gray of Cairo, Egypt, who in 1925 developed a course in general chemistry. Though a manual was published, these methods did not take root in the teaching of general college and high school chemistry. The main reason is probably that these early attempts introduced actually micro methods, that is, the work involved a drop of the liquid, or a few milligrams of a solid. It was not until the micro methods were changed to semi-micro that they found a place in the college curriculum, in the teaching of Qualitative Analysis. Engelder at the University of Pittsburgh introduced such a course at about 1930 and published his first results in 1932.

This marks the beginning of a rapid growth in the introduction of the semi-micro methods to the teaching of Chemistry. Today about 75 per cent of the colleges and universities use the semi-micro technic in the teaching of Qualitative Analysis.

Although the semimicro technic has been introduced widely in the teaching of qualitative analysis only limited progress has been done in the introduction of these methods in the teaching of general chemistry both at the college and high school level. As shown by the bibliography there have been a few attempts but the method has not yet taken root. The introduction of the semi-micro methods to the teaching of elementary organic chemistry did not start until recently. The difficulties in this field are much greater. Special glass equipment such as condensers and distillation flasks for handling small amounts had to be developed first before any of the traditional experiments can be adapted to the new technic.

The war has brought great demands for economy not only of materials but also of time; it seems therefore imperative that teachers should reexamine their disinclination to stray away from the easy beaten path of the tried and true traditional methods. The semi-micro technic for teaching sacrifices none of the objectives of any laboratory course in chemistry—and in addition offers a number of distinct advantages. On the basis of the experience of teachers who have worked with these methods the following advantages may be safely claimed: (1) The factual material of chemistry and the illustration of principals can be illustrated as well with 0.5 g. as with 10 g.; (2) Technics, cleanliness and accuracy are better and more highly developed by the micro methods than by the traditional micro methods; (3) A smaller initial investment for equipment and what is more important, less breakage and up keep; (4) The student is enabled to do

a great deal more in the time available without sacrificing thoroughness; (5) The accident hazard is reduced; accidents become micro accidents; (6) The micro methods can be well adapted to develop the student's curiosity for self-development. The hobby of the "home laboratory" which is difficult or impossible with macro equipment not only can be encouraged but it can be used to greater advantages. The space needed at home is very small, with little or no fumes or odors. The following is a partial bibliography of micro and semi-micro methods for the teaching of chemistry.

1. *Micro Methods of Quantitative Organic Analysis*, J. B. Neiderl and Victor Neiderl, John Wiley and Sons, (1942).
2. *Semi-Micro Methods in High School Chemistry*, S. D. Law, Science Teacher, Vol. 9, No. 2, 16, (1942).
3. *Semi-Micro Equipment for High School and College Chemistry*, W. J. Schiller and Sister N. Lawrence, J. Chem. Educ., Vol. 18, 543, (1941).
4. *Semi-Micro Chemistry for the Beginning Student*, V. E. Wood and H. R. Walker, J. Chem. Educ., Vol. 18, 427, (1941).
5. *Advances of Semi-Micro Technic in Teaching Qualitative Analysis*, P. Arthur, J. A. Burrows, O. M. Smith and E. L. Adams, J. Chem. Educ., 18, 385, (1941).
6. *Semi-Micro Qualitative Analysis for College Freshmen*, J. L. Dalton, J. Chem. Educ., 17, 182, (1940).
7. *The Use of Semi-Micro Technic in Elementary Organic Chemistry I*, N. D. Cheronis, J. Chem. Educ., 16, 28, (1939). *Semimicro and Macro Organic Chemistry*, N. D. Cheronis, Crowell, (1942).
8. *The Use of Semi-Micro Methods in Undergraduate Instruction*, E. Degering, J. Chem. Educ., 16, 276, (1939).
9. *The Teaching of Qualitative Analysis by the Semi-Micro Methods*, G. W. Smith, J. Chem. Educ., 75, 324, (1938).
10. *A Laboratory Manual for High School Chemistry with Semi-Micro Methods*, Schiller and Lawrence, Welch Mfg. Co., (1938).
11. *The Teaching of Micro Chemistry*, J. B. Neiderl, J. Chem. Educ., 13, 254, (1936).
12. *Semi-Micro Methods in Qualitative Analysis*, Engelder, Dunkelberger and Schiller, John Wiley and Sons, (1936).
13. *The Teaching of Micro Chemistry*, A. A. Benedetti-Pichler, J. Chem. Educ., 13, 253, (1936).
14. *Microburner*, V. T. Jackson, J. Chem. Educ., 12, 216, (1935).
15. *Semi-Micro Qualitative Analysis*, Hoggness and Johnson, Henry Holt and Co., (1935).
16. Benedetti-Pichler and Spikes, *Introduction to the Micro-technique of Inorganic and Qualitative Analysis*, Microchemical Service, Darglaston, L. I., N. Y., (1935).
17. *Gas Generator for Micro Chemistry*, S. Susman, J. Chem. Educ., 11, 375, (1934).
18. *Microchemical Qualitative Analysis Without Sulfides*, E. M. Gerstenzang, J. Chem. Educ., 11, 369, (1934).
19. *The Role of Micro Chemistry in Chemical Education*, Paul E. Spoerri, J. Chem. Educ., 10, 491, (1933).
20. *Laboratory Directions in Micro Inorganic Chemistry*, Hjort and Woodward, Edwards Bros., Inc., Ann Arbor, Mich., (1933).
21. *Increasing the Sensitivity of Chemical Reactions*, E. W. Blane, J. Chem. Educ., 10, 746, (1933).
22. *Micro Methods in General Chemistry*, Hjort and Woodward, J. Chem. Educ., 9, 1815, (1932).
23. Engelder and Schiller, *A System of Qualitative Microanalysis*, J. Chem. Educ., 9, 1636, (1932).
24. *Microchemical Laboratory Manual*, Emich-Schneider, John Wiley and Sons, (1932).
25. *Practical Methods by Micro Methods*, E. C. Grey, W. Heffer and Sons, Cambridge, England, (1925).
26. *Quantitative Organic Micro Analysis*, Fritz Pregl, P. Blakiston's Son and Co., (1924).
27. *A Manual of Microchemical Analysis*, H. Behrens, MacMillan, (1894).