Introductory Notes On Quantitative Chemical Analysis

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INTRODUCTORY NOTES
ON
QUANTITATIVE CHEMICAL ANALYSIS

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by
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PREFACE.

The forerunner of this book was a little volume printed in 1898 and containing practically the same selection of laboratory exercises as given in the following pages. This was exhausted in the course of five or six years and was followed by an extended series of mimeographed notes by way of preparation for a second and enlarged edition. These notes contained, in addition to the directions for laboratory work, a great deal of general matter as found in the present pages but not arranged in the same way. They were used several years and were then rewritten in the present form. A limited number was printed and used during a year not only in the author's classes but also by several other teachers. On the basis of this year's experience the whole matter was again gone over and minor changes made. The result is the present volume. It aims to present the beginning work in quantitative analysis in such a way that the student will be led to think more of the general aspects of the subject than of learning merely to carry out a succession of methods.

No claim of originality is made for this idea for it is unquestionably the aim of every good teacher of the subject. The claim is made, however, that in the following pages more than the usual amount of descriptive and explanatory matter is given in its general sense rather than in immediate connection with the laboratory exercises.

The idea that much could be gained by laying greater emphasis on this form of presentation has been growing in the author's mind for a number of years. While the notes previously in use contained fully as much of such general matter as the average text-book, yet it was observed that the majority of the students did not seem able to think of such points apart from their application to the particular laboratory exercise in connection with which they first learned them. For example, the account of how to make a sodium carbonate fusion was given under limestone analysis, and recitations on the subject usually took this trend:
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Professor (desirous of developing the idea that all insoluble silicates can be fused). "Describe the method of making a sodium carbonate fusion."

Student. "You take the residue from the limestone——"

Professor (interrupting in order to emphasize the point). "But why bring in limestone? Can not other insoluble material be fused?"

Student (looking blank), "I suppose so."

Professor. "Then describe the procedure of making a fusion so that it will fit any material."

Student. "You mix the residue——"

Professor. "But suppose there is no residue. We have already learned that samples that are not readily attacked by acids are fused directly. Can not a fusion be described in a way to include this condition?"

Student. "I guess so."

So it would go on and after much effort and loss of time, the recitation would develop that fusing with sodium carbonate is a general method for decomposing a certain class of substances, and that there is a proper relation by weight between the material to be fused and the amount of carbonate to employ, and that the fusion is made in a certain way, etc, etc. Similar struggles would be held with other general points, such as ignition of precipitates, filtration, washing, titration and the like, and yet, if by chance the final examination contained the question, "Describe method of making a sodium carbonate fusion," sixty per cent. of the class, at least, would begin, "You take the residue from the limestone——"

There was evidently something wrong with the method of presentation and accordingly the experiment was made of giving as much as possible, even to details of manipulation, in a general way rather than in connection with some specific laboratory exercise. The material of the old notes was rewritten from this point of view, and the results show the value of the new method; for now the large majority of the class, when called upon to recite on the topic of fusing with sodium carbonate, will begin: "The finely ground sample is mixed in a platinum crucible with five or six times its weight of sodium carbonate, etc, etc."

On the other hand, the author does not believe that a study of general procedures will lay a solid foundation for quantitative chemistry unless it is accompanied by a series of thoroughly prac-
tical laboratory exercises. The nature of this laboratory work is largely a matter of indifference, provided it be graded in point of difficulty, beginning with determinations that are relatively easy, and that it furnish a variety of manipulative experience, and last but by no means least, that constant check be kept on the accuracy of the student's work. It is further a whim of the author that the substances analyzed should in large measure be natural or manufactured commercial products.

In the Ohio State laboratory a line of analyzed samples is kept. These are given to the students by number, the rule being that at least two satisfactory results must be obtained on each determination. In addition, some of the standard solutions are also checked by the instructor. Working in this way and on a basis of four hours a week college credit, the average student occupies a year in accomplishing what is in this book. If more laboratory work is desired, references are given to other textbooks. This is done designedly, for a little practice at the end of the year with laboratory work depending upon references outside the familiar text-book has a value all its own. Small classes can easily use the library and in the case of larger numbers the mimeograph can be brought into requisition to furnish copies of the essential matter from other sources. This has the advantage, not only of giving a certain leeway to the teacher but even of forcing him to take it.

Other points that have received particular attention will only be mentioned. They are: (1) Discussion of errors (sections 34, 35, 78 and 115). (2) The method of treating normal oxidizing and reducing solutions (section 104). (3) The keeping of laboratory notes (sections 73 to 75).

Acknowledgement is made of the help afforded by such works as those of Lord, Talbot, Morse, Treadwell-Hall, Washington, Hillebrand and others. The author also wishes to express here his appreciation of the help and encouragement of his friends and colleagues, Dr. Withrow, Dr. Wilkinson and Mr. Sweeney.

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