

THE ELEMENTS OF QUALITATIVE ANALYSIS

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The Elements of Qualitative Analysis by Wm. A. Noyes

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WM. A. NOYES

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QUALITATIVE
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OF
QUALITATIVE ANALYSIS

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SIXTH EDITION

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WILLIAM A. NOYES

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PREFACE TO THE FIRST EDITION.

Two reasons have led to the writing of this book. One has been the desire to give to my classes a scheme for qualitative analysis in which points where a beginner is liable to make mistakes are especially guarded by careful and explicit directions for procedure. In this respect the book is the result of considerable experience with classes in the laboratory, where especial pains have been taken to discover the reasons for errors on the part of ordinary students. Qualitative analysis is of no value unless it leads to *certain* results, and the beginner needs to have it impressed upon his mind that certainty can only be attained by performing each operation in exactly the right way. In the author's opinion it is better to teach the student the right way at first, rather than to give only an outline and expect him to fill in the details of manipulation for himself. Every one who has had experience in the matter knows, however, that no amount of careful direction in a text-book can supply the place of constant watchfulness on the part of the instructor.

The second reason for the book has been the desire to connect the reactions given by way of a study of the elements before actual analysis more closely with the course of analysis itself. With this end in view, the reactions given for the student to try before taking up the actual analysis are chosen and arranged in each case with reference to their immediate use in the separation and detection of the elements under consideration. As a result, the preliminary reactions given are fewer in number than is usually the case. These reactions are supplemented, however, by the tables given at the close of Part I. For the idea embodied in these tables and, indeed, for most of the

matter which they contain I must acknowledge my indebtedness to Biedermann's "Chemiker-Kalender" for 1887.

The plan to be followed in using this book is largely implied in the text. In the first part of the work it is my custom to have the student perform the preliminary experiments with the metals of a group, writing the equations representing the reactions involved and keeping a careful record of his work. A mixture containing all of the metals of the group is then given and he is required to analyze it, keeping in some systematic form a record of each reagent used and of the results obtained. When the analysis is complete he is required to explain his record and give the reason for each operation. Then mixtures containing part of the metals of the group are given. After completing the study of the metals in this way, simple salts containing one metal and one acid are given for analysis and then general mixtures of various kinds.

The author will be very glad of any corrections or suggestions for improvement which may occur to anyone who uses the book.

W. A. N.

PREFACE TO THE SIXTH EDITION.

Owing to a desire to bring the book up to date, especially in consequence of the researches of A. A. Noyes and his co-workers, and to the further desire to incorporate in the text the subject-matter for which the students in qualitative analysis at this university are held responsible, the book has been very largely rewritten. The chief alterations made necessary by the work of A. A. Noyes were the introduction of the provisions for the proper conditions of acid concentration in the precipitation of the Hydrogen Sulphide Group, and also in the separation of arsenic, antimony and tin; the rewriting of the entire procedure for the analysis of the Ammonium Sulphide Group, which, owing to the above-mentioned researches, has been very greatly simplified; and the introduction of a systematic procedure for the preparation of the solution to be analyzed for the metallic elements. The procedure for the detection of acids has also been largely rewritten. The general plan of the book, however, has remained unaltered.

After having performed the preliminary experiments with the metals of a group, the beginner is required to analyze a solution known to contain all the metals of the group *in given quantities*. Then solutions containing certain metals of the group (and sometimes of preceding groups as well) are given. Finally, solutions which may contain members of all five groups are given for analysis. Following this work, the reactions of the anions are studied, after which general mixtures of solids are given for analysis. The latter are made more and more difficult as the analyst's experience increases.

URBANA, ILL.,
January, 1911.

W. A. N.
G. McP. S.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial reporting and auditing. The text notes that incomplete or inaccurate records can lead to significant errors and potential legal consequences.

2. The second part of the document outlines the various methods and tools used for data collection and analysis. It mentions the use of spreadsheets, databases, and specialized software to ensure that data is organized and accessible. The importance of data integrity and security is also highlighted, as well as the need for regular backups and updates to the systems used.

3. The third part of the document focuses on the process of data analysis and interpretation. It describes how raw data is processed and analyzed to identify trends, patterns, and anomalies. The text discusses the use of statistical methods and data visualization techniques to present the findings in a clear and understandable manner. It also mentions the importance of cross-verifying data from different sources to ensure accuracy.

4. The fourth part of the document discusses the challenges and limitations of data analysis. It notes that data can be incomplete, inconsistent, or biased, which can affect the results of the analysis. The text also mentions the need for skilled personnel to interpret the data correctly and the potential for human error in the process.

5. The fifth part of the document concludes by summarizing the key points and emphasizing the overall importance of a systematic and thorough approach to data management and analysis. It encourages the use of best practices and continuous improvement to ensure the highest quality of results.

QUALITATIVE ANALYSIS

INTRODUCTION.

Under analytical methods are understood all the operations which are made use of in order to detect in, or obtain from, chemical compounds or mixtures of chemical substances the separate parts of which they are composed. The branch of chemistry under which these methods are treated is called analytical chemistry. Analytical chemistry itself is subdivided into two general parts:

- (1.) QUALITATIVE ANALYSIS.
- (2.) QUANTITATIVE ANALYSIS.

Qualitative analysis, with which we are here concerned, deals with the qualitative composition of bodies; *i.e.*, with the separation (either free or in the form of characteristic compounds) and identification of the various elements present in them.

In the course of a qualitative analysis it is usually necessary to transform an element into a number of different compounds, successively, either because the compound first formed is so similar to some compound of another element that it cannot be identified with certainty, or because it is necessary to separate the element from others with which it is mixed or combined. The substances of known behavior by means of which such transformations are brought about are called **reagents**.

A qualitative analysis to be successful must prove with *certainty* that the elements sought are present or that they are absent. The latter is in many cases more important than