

**A COURSE OF  
QUALITATIVE  
CHEMICAL ANALYSIS**

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A Course of Qualitative Chemical Analysis by Wm. Geo. Valentin

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**WM. GEO. VALENTIN**

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A COURSE OF  
QUALITATIVE CHEMICAL  
ANALYSIS

WITH 19 ENGRAVINGS ON WOOD

BY

WM. GEO. VALENTIN, F.C.S.

PRINCIPAL DEMONSTRATOR OF PRACTICAL CHEMISTRY IN THE ROYAL SCHOOL OF MINES AND  
SCIENCE TEACHING SCHOOLS, SOUTH KENSINGTON.



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## PREFACE

### TO THE SECOND EDITION.

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IN preparing a Second Edition of my Laboratory Text-Book I have complied with a generally expressed wish, and have separated, for the convenience of a large number of students, the first or elementary part from the second part, comprising a course of qualitative chemical analysis. Few alterations only were required in this volume, in making which I have been guided by my own experience of its working with a large Laboratory Class, and by a desire very widely entertained by practical teachers. An alternative method for the examination of the precipitate produced by ammoniac chloride, ammonia, and ammoniac sulphide in Group III has been inserted in a tabular form at page 50, which, when worked with proper care, will be found easier of execution and yet sufficiently accurate.

Convinced as I am that the reactions by which the rarer elements may be distinguished can only be studied properly by taking full cognisance of their history, and as this is not done at present in the usual Lecture Courses, I have thought it best to abstain from unnecessarily complicating the systematic course of qualitative analysis, and to insist rather upon a more thorough mastery of the reactions of the common elements and their compounds. My experience is that a student readily practises those special methods which are usually followed when rarer metals are supposed to exist in any substance under examination, when once he has thoroughly mastered the general methods.

For similar reasons little or no cognisance has been taken of the more recent brilliant additions to our analytical know-

ledge in the form of Spectral Analysis, especially as it is within my knowledge that an elementary treatise on Spectral Analysis will shortly be published by those most capable of dealing with this subject. Spectral Analysis, with all its appliances, must form a special branch of chemical analysis, if it is to be dealt with as it deserves.

The analytical tables, which are the result of long experience in the laboratory, are now for the first time published also in a separate and less destructible form, printed on Messrs. De la Rue's parchment paper.

In conclusion, I have to thank Mr. Geo. Chaloner, of the London Association of Correctors of the Press, for his valuable assistance in the arduous task of correcting proof-sheets.

CHEMICAL LABORATORIES,  
SCIENCE SCHOOLS,  
SOUTH KENSINGTON,  
*January 1, 1878.*

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A COURSE  
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CHAPTER I.

**DEFINITION OF QUALITATIVE ANALYSIS.—RE-  
AGENTS.—CHEMICAL OPERATIONS.—GROUP-  
REAGENTS AND SPECIAL REAGENTS.**

CHEMICAL analysis consists in the performance of certain experiments:—with the object of putting, so to speak, certain questions to a substance, in order to ascertain the presence or absence of certain bodies. It is termed *qualitative* analysis, if the answer which is received reveals merely *what kind* of matter is present (from *qualis*), without regard to quantity. It is essential that these questions should not be put at random, but according to a well-considered, systematic order; and that the answers should be interpreted correctly.

We have already seen, that there exists a resemblance between certain elementary as well as certain compound bodies; at the same time the metallic, like the non-metallic elements, bear the stamp of a marked individuality which renders every classification, from whatever point of view we attempt it, more or less difficult—a difficulty which extends likewise to the various compounds which the elements form. Thus silver, which is classified with the monad metals potassium and sodium, differs in a marked manner from the alkali metals. Iron, which exists in the dyad form in  $\text{FeCl}_2$  (ferrous chloride), and in the tetrad condition in  $\left\{ \begin{array}{l} \text{FeCl}_3 \\ \text{FeCl}_4 \end{array} \right.$  (ferric chloride), partakes in the dyad form of the character of the isomorphous diatomic metals of the magnesium group, *e.g.*, manganese and zinc, and resembles in the tetrad form aluminum and chromium. Copper, which in its cupric compounds offers certain points of resemblance to the magnesium group, resembles also in many respects the metals of the mercury group;\* the general composition of the cuprous and mercurous and the cupric and mercuric oxides and chlorides being the same. Inorganic (as well as organic) compound bodies bear, for the most part, the impress of the elementary bodies which enter into their composition; and compounds built up of elements which have equal numbers of bonds, frequently show a certain analogy in their structure as well as a

\* H. Wurtz, *Leçons de Philosophie chimique*, p. 170.

considerable similarity in their reactions. In studying the chemical changes to which the various bodies—elementary or compound—can be submitted, our attention must be mainly directed towards discovering and defining this similarity and dissimilarity.

We employ *reagents* as the means of producing chemical changes. By *reagents* are meant bodies—either elementary or compound—which are capable of *reacting* upon and revealing to us the nature of the substances under examination. They are usually divided, without any strict line of demarcation, into two classes; *viz.*, *general* and *special reagents*. General reagents are those which separate a number of substances—groups in fact—at one operation; and special reagents those which are used to a limited extent only, and for the detection of *individual* substances.

In a laboratory the general reagents are most conveniently arranged over the working table within reach of each operator; whilst the special reagents intended for the use of a number of chemical students, are usually placed in a freely accessible part of the laboratory.

A list of reagents, as well as directions for their preparation, will be found in the Appendix. Chemical students who have not the advantage of working in a well-appointed laboratory, should devote much attention and care to the preparation of the reagents.



FIG. 1.

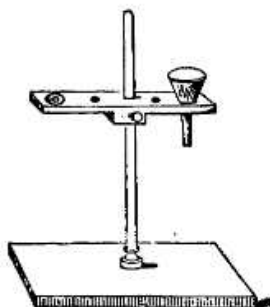


FIG. 2.

**Chemical Operations.**—We add a **reagent** to a solution of an unknown body either by pouring it directly from the bottle, or by running it from a pipette, as shown in Fig. 1, with the view of producing a **precipitate**, *i.e.*, of converting the body from the soluble to the insoluble state. The reaction which takes place is mostly a *change by double decomposition*. Sometimes a precipitation is produced by voltaic action, sometimes merely by the substitution of one solvent for another. One or more bodies may be precipitated by one and the same reagent. As most precipitates are heavier than the liquid in which they are suspended, they fall to the bottom with more or less rapidity; and the supernatant liquid may often be poured off or **decanted**, without much disturbing the precipitate. This mode of separating fluids from precipitates is by far the most expeditious, and should be resorted to whenever it is applicable. The precipitate may be washed in the vessel itself by treatment with hot water and repeated decantation.

When a large quantity of a fluid has to be removed from a precipitate, it is best to **siphon** off the supernatant fluid. The precipitate may be washed with water, and the wash-water siphoned off repeatedly.

Small quantities of a precipitate which do not subside readily are more quickly separated by **filtration**. For this purpose