# THE ELEMENTS OF QUALITATIVE CHEMICAL ANALYSIS WITH SPECIAL CONSIDERATION OF THE APPLICATION OF THE LAWS OF EQUILIBRIUM AND OF THE MODERN THEORIES OF SOLUTION

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649572281

The Elements of Qualitative Chemical Analysis with Special Consideration of the Application of the Laws of Equilibrium and of the Modern Theories of Solution by Julius Stieglitz



Edited by Trieste Publishing Pty Ltd.
Cover @ 2017



www.triestepublishing.com

JULIUS STIEGLITZ

# THE ELEMENTS OF QUALITATIVE CHEMICAL ANALYSIS WITH SPECIAL CONSIDERATION OF THE APPLICATION OF THE LAWS OF EQUILIBRIUM AND OF THE MODERN THEORIES OF SOLUTION

Trieste

# THE ELEMENTS
OF
# QUALITATIVE CHEMICAL ANALYSIS

WITH

SPECIAL CONSIDERATION OF THE APPLICATION OF THE LAWS OF EQUILIBRIUM AND OF THE MODERN THEORIES OF SOLUTION

BY

JULIUS STIEGLITZ
PROFESSOR OF CHEMISTRY, THE UNIVERSITY OF CHICAGO

THE KENT CHEMICAL LABORATORY OF THE UNIVERSITY OF CHICAGO
CHICAGO (1908)

Stanhope Press
F. H. GILSON COMPANY
BOSTON, U.S.A.

# PRELIMINARY STATEMENT.

PART I of this book, which is in preparation, will contain the theoretical development of the subject of Qualitative Chemical Analysis as presented in the lectures of the author in the University of Chicago for the last thirteen years. It will include a discussion of the development and experimental foundations of the modern theories of solution; of the application of the laws of chemical and physical equilibrium to reactions used in analytical chemistry; of the theory of complex ions; and of the electric theory of oxidation and reduction; all with special attention to substantiating the theoretical treatment by lecture experiments.

Parts II and III, which are given in the present book, include the instructions for laboratory work introductory to systematic analysis and for systematic analysis. The attempt has been made, in particular, to bring the laboratory work, which otherwise follows the usual lines of instruction in systematic analysis, *also into closest relations to the development of the scientific foundations of analytical chemistry*, as presented in Part I. It is believed that the subject matter lends itself especially well to such a close interweaving of the two sides of the study, without any special loss of time to the student, and with the result, it is hoped, of a greatly increased interest on his part and an increased stimulus of the habit of scientific thought.

In the theoretical treatment the author is indebted to the original articles of van't Hoff, Arrhenius, Ostwald, Nernst, Bodlaender, Walker, etc., and, in particular also, to Ostwald's "Wissentschaftliche Grundlagen der Analytischen Chemie" which in 1894 first suggested the teaching of analytical chemistry along the lines followed here. For more extended reference on subjects of descriptive general chemistry, Alex. Smith's "General Inorganic Chemistry" and Remsen's "Inorganic Chemistry (Advanced)" are used. In the systematic analytical treatment, acknowledgment is due especially to Fresenius' Qualitative Chemical Analysis (frequent reference is made in the text to H. L. Wells' translation) and, for some special matters, to the work of W. A. Noyes of the University of Illinois, and of A. A. Noyes, of the Massachusetts Institute of Technology.

Special thanks are due to Professor Lauder W. Jones of the University of Cincinnati and to Dr. H. I. Schlesinger of the University of Chicago for their critical scrutiny and assistance in the preparation of the manuscript and correction of proof.

THE AUTHOR.

CHICAGO, May, 1908.

# QUALITATIVE ANALYSIS.

## PART II

### A. REACTIONS OF THE METAL IONS

#### The First or Alkali Group

*Potassium*, $K^{\cdot}$; *Sodium*, $Na^{\cdot}$; and *Ammonium* $(NH_4)^{\cdot}$, *Ions.*

1. Test aqueous solutions of each of the following compounds with neutral (violet) litmus paper, comparing the tints with that of a piece of the paper put into pure water:

(*a*) Potassium, sodium and ammonium hydroxide; test also the vapor above the solutions. Interpret the results.

(*b*) Sodium chloride, potassium carbonate. The interpretation of the results will be given in the "Aluminium Group."

2. (*a*) Add a little water to some calcium oxide in a small beaker to slake it, then add a few c.c. of ammonium chloride solution, and place a watch-crystal over the beaker with moist pieces of neutral and red litmus paper sticking to the lower side of the watch-crystal. Judging by 1 (*a*), would potassium and sodium salts react in the same way as ammonium chloride?

(*b*) Repeat the test in 2 (*a*), using lime-water in place of slaked lime. Compare (*a*) and (*b*). Which gives the better result? Which will give a more concentrated solution of ammonium hydroxide? Express by the equilibrium law applied to the dissociation of ammonium hydroxide into ammonia and water how the concentration will affect the test.

3. Heat a little of each of the following solid salts in a porcelain dish or crucible with the free flame, but below red heat: potassium, sodium and ammonium chlorides; sodium ammonium hydrogen phosphate. Observe which salts are volatile. If any fumes are given off, test them with moistened neutral litmus paper.

4. Get 1 c.c. of a 10 per cent solution of chloroplatinic acid from the storeroom.

(*a*) Add one drop of it to a drop each of solutions of potassium, sodium and ammonium chloride. Is there any difference shown in these tests?

(*b*) Repeat the tests, but first dilute the drop of each of the salt solutions with 10 c.c. of water. Why does this method of testing not prove conclusively the absence of the metals which according to (*a*) gave precipitates of chloroplatinates? Evaporate the solutions obtained in (*b*) to dryness in porcelain dishes over a water-bath, and add two or three *drops* of cold water to the contents of each dish.

Can we distinguish potassium from sodium salts by this test? Potassium from ammonium salts? According to the result in (*b*), what are the necessary conditions for applying this test successfully?

5. Heat a little of the following salts on the end of a clean (test?) platinum wire in the non-luminous flame:

(*a*) Potassium, sodium, ammonium chloride, each separately. Clean the wire until it gives no color to the flame, allow it to cool, touch it with the fingers and hold it again in the flame. What difference is there between the behavior of this minute trace of sodium chloride and the larger quantity of sodium chloride in the flame test?

(*b*) An intimate mixture (e.g., the mixed solutions) of approximately equal parts of potassium and sodium chloride.

(*c*) (*a*) and (*b*) may be repeated, the flames being examined with the aid of the spectroscope. Consult the instructor.

6. Using the results obtained in 1 to 5, devise a scheme of analysis for detecting potassium, sodium and ammonium salts in the presence of each other, without the use of the spectroscope. Show the scheme to the instructor or assistant and ask for an "unknown."

*Characteristic of the alkali metals is that all their common salts are easily soluble in water.* The hydroxides of sodium and potassium are very strong bases, the hydroxide of ammonium a weaker one, but still moderately strong. (Lecture.)