

# QUANTITATIVE PHARMACEUTICAL CHEMISTRY

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THIRD EDITION  
THIRD IMPRESSION

## PREFACE

Since the publication of the second edition of this book, numerous changes have been made in the official methods of analysis of pharmaceutical materials in the United States Pharmacopoeia XIII and in the National Formulary VIII. The detailed procedures and discussions have been changed or rewritten in the present edition to conform to the revised official methods.

The object of this book is twofold: First, to furnish students of pharmacy with a systematic course covering all the quantitative chemical and physical methods official in the United States Pharmacopoeia and the National Formulary through the selection and explanation of typical procedures; second, to present some of the generally applicable, nonofficial methods of analysis that are widely used in pharmacy and with which all students pursuing the profession should be familiar. In both instances, the theory and practice of analytical chemistry as applied in quantitative pharmaceutical procedures have been correlated.

The use of the book as a text should be supplemented by lecture and recitation instruction. It is obviously impracticable to include detailed explanations of all of the quantitative determinations in the Pharmacopoeia and the National Formulary. Typical analyses illustrating all the various methods have therefore been selected and explained in considerable detail, whereas those determinations requiring the same or closely similar procedures are indicated in tables or otherwise. The instructor may select other determinations from the Pharmacopoeia or the National Formulary and assign to the students the task of applying the theory and explanation of the procedure involved as given in the text.

The contents of the book is arranged into three parts. Part 1 treats of general methods of gravimetric and volumetric analysis, Part 2 treats of physicochemical methods, and Part 3 contains the special methods of pharmaceutical analysis.

The authors wish to acknowledge their appreciation of the courtesy extended by the following companies which granted permission to use illustrations from their catalogues and books: A. H. Thomas Company; Bausch and Lomb Optical Company; Central Scientific Company; Christian Becker, Incorporated; E. H. Sargent and Company; LaMotte Chemical Products Company; and Leeds & Northrup Company.

The wide popularity that the first and second editions of this book have enjoyed among students and teachers has been gratifying. It is hoped that the new edition will similarly commend itself to a still larger circle. To the many kind friends who have so generously aided by means of helpful suggestions, the authors desire to express their thanks.

THE AUTHORS

*January, 1949*

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## INTRODUCTION

*Quantitative pharmaceutical analysis* may be defined as the application of the procedures of quantitative analytical chemistry to the analysis of the materials used in pharmacy and, especially, to the determination of the purity and quality of the drugs and chemicals official in the United States Pharmacopoeia and in the National Formulary. A complete chemical analysis of any substance requires the establishment of the identity of its component parts by qualitative analysis and the determination of the proportion in which these components are present by the processes of quantitative analysis.

Quantitative chemical methods are commonly classified as organic and inorganic; gravimetric, volumetric, gasometric, and electrometric. It is impractical, however, to adhere strictly to this classification in presenting the subject matter of quantitative pharmaceutical analysis since certain phases of the work, as alkaloidal assaying and the assay of essential oils, have been developed to a point where they constitute a distinct subject matter in which the principles involved and the technique required are the same whether the procedure be gravimetric or volumetric.

Quantitative pharmaceutical analysis may be appropriately subdivided according to various procedures, each of which requires a special technique, as follows:

*Gravimetric analysis*, or the separation, by extraction, precipitation, or other means of the constituent to be determined either in the natural state, or in the form of a definite compound the composition of which is known to the analyst, and weighing the resulting product.

*Volumetric analysis*, or the determination of the volume of a solution of known concentration required to react with a given amount of the substance to be analyzed.

*Gasometric analysis*, or the measurement of the volume of a liberated gas or the decrease in volume of a mixture of gases when a suitable reagent is used to remove one of the gases present.

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*Physicochemical methods of analysis*, or those which are based on the utilization of some specific physical or chemical property or properties of the substance in its quantitative estimation. Those physicochemical methods commonly applied in quantitative pharmaceutical chemistry are *optometric*, *refractometric*, *electrometric*, and *colorimetric*. They comprise some of the most valuable methods used in analytical procedure. Since each of them requires special treatment, they will be discussed separately.

*Special methods*, or those which require a distinct type of technique, as alkaloidal assaying, require separate treatment in order to preserve unity of subject matter.

The official assay methods serve as an exact measure of the purity of a substance only when the results are considered in conjunction with the qualitative tests. Thus, in the assay of zinc oxide, the purity of the oxide as determined by assay must follow qualitative tests for other metals which if present would be estimated as zinc oxide. A complete analysis, therefore, requires the qualitative estimation.

The theoretical considerations applicable in any given analysis are inherently a part of the analytical procedure. They should be mastered before a determination is made and carefully applied throughout each step of the procedure.

Those who desire a more comprehensive treatment of special aspects of analytical procedure will find the following texts and reference books of value:

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2. FOULK, "Introductory Notes on Quantitative Chemical Analysis," H. L. Hedrick, Columbus, Ohio, 1940.
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