SYNTHETIC INORGANIC CHEMISTRY: A LABORATORY COURSE FOR FIRST YEAR COLLEGE STUDENTS

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649717194

Synthetic Inorganic Chemistry: A Laboratory Course for First Year College Students by Arthur A. Blanchard

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

www.triestepublishing.com

ARTHUR A. BLANCHARD

SYNTHETIC INORGANIC CHEMISTRY: A LABORATORY COURSE FOR FIRST YEAR COLLEGE STUDENTS

Trieste

SYNTHETIC INORGANIC CHEMISTRY

A LABORATORY COURSE FOR
FIRST YEAR COLLEGE STUDENTS

BY

ARTHUR A. BLANCHARD, PH.D.

Associate Professor of Inorganic Chemistry at the Massachusetts Institute of Technology

SECOND EDITION, WITH SUPPLEMENT
FOURTH THOUSAND

NEW YORK
JOHN WILEY & SONS, INC.
LONDON: CHAPMAN & HALL, LIMITED
1916

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

PREFACE

THIS series of notes was designed to serve as a guide for laboratory work and study in Inorganic Chemistry during the second term of the first year at the Massachusetts Institute of Technology. It had been felt for some time that Qualitative Analysis, which was previously made the basis for laboratory practice during that period, did not fully meet the requirements and that a course based upon the actual preparation of typical chemical substances might prove more satisfactory. In consequence, notes in essentially the form now published were prepared during the year 1906–07, they being the direct outcome of several years' previous trial of a limited amount of preparation work with the classes. The present book is a thorough revision of those notes in the light of experience in their actual application.

During the first term's study of chemistry there can be little doubt that a course of simple experiments, such as has long been in use, in the methods of formation and in the study of the properties of the non-metallic elements — oxygen, hydrogen, the halogens, sulphur, nitrogen, and carbon — and their compounds, is the most satisfactory. But when it comes to the study of the metallic elements, three options as to laboratory work present themselves: First, a continuation of experiments similar in nature to those of the first term; second, Qualitative Analysis; third, Preparation Work. The disadvantages of the first plan are that the experiments are so quickly performed and so alike in character that they fail to arouse much enthusiasm in the student or to leave very vivid impressions on his mind. Qualitative analysis is in many ways a most excellent basis for teaching the chemistry of the metallic elements; but its chief disadvantages are: First, that it is one-sided, it dealing as it does

almost exclusively with the chemistry of solutions and the formation of highly insoluble bodies; second, that it requires the sequence followed in the lectures to be that of the qualitative procedure instead of a more natural one based on the periodic classification; and third, that it is well-nigh impossible to keep from the student's mind the false idea that the end and aim of qualitative analysis is principally "to get the unknowns correct."

Some of the advantages which seem to be possessed by a course of preparation work such as outlined in the following pages are:

1. The sequence of the exercises may follow that of the lectures.

2. Very varied types of chemical change are illustrated, both those in the furnace and those in solution. In solution advantage is taken not only of high degrees of insolubility, but also of differences in solubility among the more soluble bodies as well as of differences in the effect of temperature on solubility.

3. The danger of the work becoming a mechanical following of directions is reduced by the introduction of study questions and experiments with each exercise.

4. In its effect in awakening the student's interest this line of work has proved particularly successful,— the making of preparations is, in fact, in its very nature one of the most fascinating forms of chemical work. Since each preparation requires a good deal of time and thought, and the product when obtained is something definite and tangible, the knowledge thus gradually absorbed is more definite and less easily forgotten than when the laboratory work consists of a large number of test tube reactions.

After the completion of such a course as this, if the student commences analytical work with some conception of the sources and methods of obtaining the substances

which he is to use as reagents, etc., there can be no doubt that the latter work will then have a much deeper meaning.

The plan kept in mind in preparing this course is, briefly, as follows: The greater part of the preparations selected are of industrial importance, and for the starting point of each either natural products or crude manufactured materials are used so far as is possible. The course does not aim to be an exhaustive one in chemical preparations, but a limited number of exercises are selected to illustrate the most important types of compounds of the common elements and the most important methods. Two or three times as many exercises are furnished as any one student will be able to complete in the time usually allotted; thus different students may be assigned different preparations.

The notes for each exercise are divided into three parts: I. A discussion of the object of the exercise, with an outline of the principle of the method and the reasons for the steps involved. II. Working directions which, if carefully followed, should result in obtaining a satisfactory product. It is believed far better to make the directions very explicit, for the reason that the inexperienced student may easily become discouraged by failures due to difficulties which he is unable to foresee. Difficulties enough are sure to arise to develop originality and resourcefulness. III. Questions for study which involve additional laboratory experiments, the consulting of text-books, and original reasoning.

At the end of each group of exercises is furnished a set of general study questions, and this arrangement of the exercises in groups is such as to bring out the relationships shown in the periodic classification of the elements.

In the discussions and questions given with the various exercises it is assumed that the student has an elementary knowledge of the electrolytic dissociation theory and of the principle of mass action. In the opinion of the author

a great opportunity is lost for bringing out relationships among chemical phenomena if these principles are not taught during the first term's study of college chemistry and their applications pointed out in connection with later work in inorganic preparations and in analytical chemistry. The effort has been to make the questions such as cannot be answered mechanically. Some of the questions may, in consequence, seem rather difficult and incapable of direct answers; the object of the questions is, however, not solely to bring forth correct statements of facts and theories, but is also to teach the student to use his head in seeking for the significance of facts and in reasoning from one fact to another.

Acknowledgment is due to many sources for the outline of the greater part of the methods given. The details of all of them have, however, been very carefully worked over and adapted for the purpose in view.

In conclusion the author wishes to express his sense of obligation to Professor Henry P. Talbot, head of the Department of Chemistry, at whose request the preparation of these notes was undertaken; also to other members of the instructing staff at the Massachusetts Institute of Technology for helpful criticism and suggestions, and particularly to Mr. J. W. Phelan, to whose efficient management of the laboratory instruction is due any success with which this course has met at this Institute.

This little book is presented for publication with the desire to offer for the consideration of those in charge of the instruction at other institutions a plan of first-year work which has quite new and perhaps advantageous features. It is hoped that it may do its part in securing recognition of the importance of synthetic or preparative work in a well-balanced course of chemical training.

ARTHUR A. BLANCHARD.

March, 1908.

PREFACE TO SECOND EDITION

THE plan of work embodied in the first edition has remained unchanged in the second edition, but many minor improvements have been made and considerable new material has been added.

Several of the procedures have been altered, so that good results may be more confidently expected from inexperienced students. A few new preparations have been added to the list in order to include important types of processes which were not well represented in the first edition. The general questions following each group of exercises have been entirely rewritten, and now present a more consistent plan to bring out the main characteristics of the various groups and the relations among the groups. The number of these questions has been considerably reduced, and it is now felt even more strongly than before that all of the general questions should be mastered by every student who takes the course. For the convenience of teachers as well as of enthusiastic students, a number of additional general questions have been placed in the appendix. An introductory section has been included, explaining principles and details of laboratory manipulation. A new chapter (Chapter VII) has been added, which embraces the non-metallic elements, and is intended to recall and to broaden the knowledge which the student was supposed to possess before commencing the study of the metallic elements. Some useful tables have been added in the appendix, and a few cuts have been inserted in the text.

June, 1910.