THE ELECTROLYTIC DISSOCIATION THEORY: WITH SOME OF ITS APPLICATIONS

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THE ELECTROLYTIC DISSOCIATION THEORY WITH SOME OF ITS APPLICATIONS

AN ELEMENTARY TREATISE
FOR THE USE OF
STUDENTS OF CHEMISTRY

BY

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PREFACE

In this little treatise the authors have sought to bring together, in small compass, material relating to the Electrolytic Dissociation Theory which is now somewhat widely distributed throughout many of our excellent text-books. The method of presentation is that which they have found serviceable in enabling their students to comprehend the main facts which are today generally accepted as supporting the Theory, and to understand its application to important types of chemical change.

While the book has been written primarily for the use of students, the authors have also kept in mind its probable usefulness to the teacher in preparatory school or college, who may desire to gain in a short time an acquaintance with the fundamental facts and principles in this interesting field. In this connection, however, they desire to express their firm conviction that this Theory should be touched upon in only the most elementary way in the secondary schools; but this does not, of course, make it less necessary that the well-informed teacher should be prepared to meet the inquiries of the occasional unusually mature and thoughtful pupil.

More has been included in this manual than the authors have found it advisable for the college student who is just beginning the study of chemical science to attempt to master, and quite as much as many students who have already had a year of chemical experience in a preparatory school will be able to thoroughly understand. Our experience has shown, however, that it is easier to maintain the interest of the thoughtful pupil if answers to some of the questions suggested to him by the discussions in the main body of the text are placed at his hand, when it is possible to do this without going too far afield. Most of the material of this nature has been printed in smaller type, and may be omitted without loss of continuity; and it is believed that in the course of a year of study the college student (even the beginner in chemistry, if he has some knowledge of physics) can be brought to understand the essential principles included in the main text. To insure this it is necessary that the instructor should lose no opportunity throughout his course to emphasize the application of a principle, after it has once been introduced.

The attempt to present the subject-matter in a simple form, and at the same time to avoid inaccurate statements, has sometimes led to a conflict of ideals, as, for example, in the application of the Law of Mass Action to strong electrolytes. Nothing is said in this connection of the unexplained fact that such electrolytes apparently do not rigidly obey this law, since to discuss this topic would seriously complicate an important statement without corresponding advantage. We believe, however, that in such cases no violence has been done to the principles of physical chemistry, and that no impressions have been given which it will be difficult for the student to unlearn if he pursues the subject to its more advanced stages.

The application of the ionic theory to indicators has been omitted altogether, as the present state of our knowledge seems to indicate that complicated rearrangements of the atoms within the molecules of organic substances are involved, with which it would be beyond the scope of this treatise to deal.

The authors desire to acknowledge their indebtedness to many of the standard text-books, and especially to Smith's "Laboratory Outline of General Chemistry" for suggestions as to laboratory experiments. They would also acknowledge the valuable assistance rendered by Dr. Miles S. Sherrill, and the friendly and helpful criticisms of other members of the instructing staff of the Massachusetts Institute of Technology.

H. P. TALBOT.
A. A. BLANCHARD.

September, 1905.

CONTENTS

CHAPTER I

EVIDENCES OF ELECTROLYTIC DISSOCIATION AFFORDED BY A STUDY OF THE PROPERTIES OF SOLUTIONS

1. If the various forms of matter are studied with reference to their ability to transmit an electric current, it is found that some, such as glass, hard rubber, or alcohol, do not allow an appreciable amount of electricity to pass through them, while others permit the passage of electricity with comparative readiness. The former are called *non-conductors*; the latter, *conductors*. The conductors, in turn, may be subdivided into two classes with reference to the manner in which they transmit the current, namely, *metallic conductors* and *electrolytic conductors*. Platinum or copper wires, or the carbon filaments of incandescent lamps, are of the first variety, and conduct the current without undergoing any permanent alterations, while in conductors of the second variety (comprising salts when in the molten condition, or solutions, particularly aqueous solutions, of acids, bases, or salts) the passage of the current is accompanied by a separation of the components of the conductor. This electrolytic conduction can only take place in fluid bodies the components of which gradually collect at the poles, that is, at the points where the current enters and leaves the fluid. Bodies which conduct in this manner are known as *electrolytes*, and the process of conduction accompanied by the separation of the constituents of the electrolyte is called *electrolysis*.

It was to explain electrolysis, together with certain other peculiar properties possessed only by those solutions which conduct electricity, that in 1887 Arrhenius, a Swedish physicist, was led to propose the Theory of Electrolytic Dissociation.

This theory assumes that a certain proportion of the dissolved molecules of electrolytes are dissociated into simpler component parts, called *ions*, and that each of these ions has an effect upon many of the properties of solutions equal to that of a whole molecule. It is the purpose