CHEMICAL THEORY FOR BEGINNERS

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Chemical Theory for Beginners by Leonard Dobbin & James Walker

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LEONARD DOBBIN & JAMES WALKER

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PREFACE

OUR object in writing this little book has been to assist beginners in obtaining an elementary knowledge of the principles upon which modern chemistry is based. The smaller text-books which deal with Systematic Chemistry usually treat theoretical matters so lightly that the student seldom obtains any satisfactory grasp of these during the earlier portion of his studies; while in the larger treatises the same subjects not infrequently receive similar scant attention, because the student is supposed to have been introduced to them already. For example, beginners are seldom made to understand the full significance of chemical formulæ, although they are usually taught to use them at a very early stage in their studies. These chemical formulæ are the outcome and embodiment of many facts and theories, and their logical introduction into a course of chemistry can only take place at a comparatively late period. Their convenience, however, is felt to be so great, that the student is usually brought face to face with them prematurely, at a time when he can neither understand their origin nor appreciate their import; and later, when he begins his more advanced studies, he is often assumed to be quite conversant with them.

In the first part of the book we have endeavoured to remedy this defect, by setting forth in a simple and connected manner, the nature of the facts (and of the theories derived from them) with which the chemist must be acquainted before he is justified in employing chemical formulæ at all.

The later chapters contain, amongst other things, an entirely non-mathematical exposition of the more important principles of General Chemistry, which has made such great progress of late years, especially in the departments of solution and electrolysis. Although the new theories in this branch of the subject are still received with reserve by many British chemists, we have not hesitated to place them before the beginner, convinced as we are of their usefulness, and of their eventual general recognition.

Many of the subjects dealt with have been intentionally, and indeed necessarily, very shortly treated. We hope, however, that enough has been said respecting the most important matters to make the book serve as an easy and yet sufficient introduction to the larger text books, both of Systematic and of General Chemistry.

L. D.
J. W.

EDINBURGH, *June* 1892.

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INTRODUCTION

ON UNITS AND MEASUREMENT

WHEN we measure anything—be it a length, a weight, a time, or any other magnitude—we express the result of our measurement by means of a number and of a name. Thus we speak of a length of 5 feet, and of a weight of 20 pounds. The name expresses the unit or standard with which we compare the quantity to be measured, and the number tells us the number of times the quantity contains this unit.

In the above instances we have adopted as unit of length the foot, and as unit of weight the pound. It evidently depends upon the choice of the unit what the number to express a certain quantity will be. 5 feet and 60 inches both stand for the same length, the unit in the second case, however, being twelve times smaller than in the first, so that it requires twelve times as many of these small units to make up the given length as it does of the larger units.

The units employed to measure length, weight, etc., in everyday life differ in different countries, but scientific men of every nationality have practically all agreed to adopt one system of units, for the sake of uniformity, and the possibility of easy comparison of the results of different observers. The system of weights and measures chosen is the French or Metric System.

The unit of length in this system for scientific purposes is the *centimetre*, which is equal to ·3937 inches. There are often used, besides the centimetre, decimal multiples or submultiples of it, when the length expressed in centimetres would give numbers either inconveniently large or inconveniently small. The relations of these to the centimetre are given in the following table—

1 centimetre (cm.) = 10 millimetres (mm.)
100 centimetres = 1 metre (m.)
1000 metres = 1 kilometre.

The unit of surface is a square measuring 1 centimetre each way, and is called the square centimetre (sq. cm.). It is equal to ·155 square inches.

For unit of volume we take a cube, each of whose edges measures a centimetre in length. This unit is called the cubic centimetre (c.c.).

1000 c.c. = 1 litre (l.) = 1·76 pints.

The unit of mass—quantity of matter—is the mass of 1 c.c. of pure water at the temperature at which water occupies the smallest volume, viz. 4° Centigrade (see p. 82). This unit is called the *gram*. Its multiples and submultiples are—

1 kilogram (kilo.) = 1000 grams (g.)
1 gram = 10 decigrams (dg.)
= 100 centigrams (cg.)
= 1000 milligrams (mg.)
1 gram = 15·432 grains. 1 kilo = 2·2046 pounds.

Since the mass of 1 c.c. of water at 4° is 1 gram, the mass of 1 litre, or 1000 c.c., of water at the same temperature is 1000 grams, or 1 kilogram. These masses are also all known, under the same names, as *weights*; we ordinarily talk of a substance being so many grams weight instead of grams mass. Strictly speaking, the