# A CATECHISM ON CHEMISTRY, INCLUDING HEAT, MAGNETISM AND ELECTRICITY

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649399871

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Edited by Trieste Publishing Pty Ltd.
Cover @ 2017



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JOHN WILMOT NEAT

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Trieste

# PREFACE.

The want of a simple Elementary Catechism on the principles of Experimental Science must often have been felt by many who are similarly engaged with myself in the instruction of youth. The following pages have been compiled in the hope that they may, in some degree, supply the lack of a manual of chemistry and its correlative sciences.

In such a work the merit of originality cannot be claimed, both because its subject-matter must necessarily be derived from books already approved, and also because I should deem it presumptuous to substitute my imperfect conclusions for the matured and established deductions of others.

All that I would claim for this little book is originality in its arrangement, simplicity in its statements, and the fact of my experience of its utility as a manual of instruction.

In the hope, therefore, that it may prove similarly useful to others, I venture to commend it to the public.

J. W. N.

Landford Lodge, Salisbury.

# QUESTIONS ON CHEMISTRY.

Q. What is Chemistry?

A. It embraces, in general terms, the study of the nature and property of all the materials which enter into the composition of the earth, the sea, and the air.

Q. Upon what kind of proof does chemical science rest?

A. It rests entirely upon experimental demonstration.

Q. What substances form the basis of chemistry?

A. Those which are called *elementary*, *i. e.* substances that are not decomposable.

Q. How many of these substances are at present known?

A. *Sixty-two*; and of these all others are compounded.

Q. Give an instance of a *simple* or *elementary* substance.

A. Iron is a simple substance, because we can only obtain iron from it.

Q. Give an instance of a *compound* body; *i. e.* of that which contains two or more simple substances.

A. A piece of limestone subjected to red heat for a short time loses nearly half its weight and becomes quick-lime — that portion of its bulk which has escaped is carbonic acid; *lime* and *carbonic acid*, therefore, combine to form the substance called limestone, which is thus shown to be of a *compound* quality.

Q. What is the proper term for the chemical separation of a substance?

A. *Chemical decomposition.* And when this has taken place, the original compound substance is said to be decomposed into its *components*, or *constituents.*

Q. Into how many classes are *elementary* substances generally divided?

A. Into two:—*metals* and *non-metallic* substances.

Q. What are the most important of the *metals?*

A. Iron, copper, lead, mercury, silver, gold, magnesium, calcium, and potassium.

Q. Name some of the *non-metallic* substances.

A. Sulphur, phosphorus, carbon, oxygen, hydrogen, nitrogen, &c.

N.B. *Oxygen* and *nitrogen* are the elements existing in the atmosphere: *hydrogen* and *nitrogen* form water.

Q. What is the *physical state* or *condition* of a substance?

A. There are *three* such states, *viz.*: the *solid*, the *fluid* or *liquid*, and the *gaseous.*

Q. Give an example of one substance passing through all these states.

A. *Water:* generally it is fluid, but when sufficiently cooled it becomes solid, and again, when subjected to a sufficient heat, it boils and afterwards becomes steam, which is the gaseous condition of water. *

Q. Define *attraction.*

A. There are various kinds of attraction:

1. *Attraction of gravitation; ex. gr.* where a stone falls to the ground in consequence of the earth's attraction.

2. *Magnetic attraction; ex. gr.* the attraction which a magnet has for soft iron.

3. *Electrical attraction;* or the attraction which any perfectly dry substance, such as sealing-wax when sharply rubbed, has for any light substance.

4. *Attraction of cohesion; ex. gr.* the attraction which one perfectly smooth surface has for

another when rubbed together with a circular motion.

5. *Capillary attraction; ex. gr.* a lump of sugar placed in water; the water rises through the sugar by capillary attraction.

Q. What is chemical affinity?

A. That union which sometimes takes place between two or more bodies in such a way as to give rise to a *new* substance, whose properties are different from those of its components.

Q. How are all chemical changes produced?

A. By *affinity*, or *chemical attraction.*

Q. Upon what is the physical state of a substance dependent?

A. Upon its relation to *heat.*

Q. What is the most general effect of heat?

A. (1st.) To cause *expansion* or enlargement.

Q. Give an example of this.

A. A piece of iron or brass when heated will be found to be larger, both in length and width, than when cold; and will, when quite cold, be found to have returned to its original size.

Q. What instrument in common use is made upon this principle?

A. The thermometer.

Q. Explain its construction.

A. A thin hollow glass tube of uniform diameter is made with a hollow glass bulb at one extremity. This bulb, by a peculiar process, is exactly filled with mercury to the top of the bulb; all remaining air is then expelled from the tube, which is then hermetically sealed by the blowpipe. The instrument now consists of the glass tube with the bulb of it filled with mercury. It is now requisite to graduate it for use. This is done either by making marks on the stem, or by fastening the tube to a scale of wood or ivory, all which marks are made according to certain rules.

Q. What are these rules?

A. In England the division of *Fahrenheit* is used. According to this scale the thermometer is graduated into 180 degrees. The zero point is placed 32 degrees below the freezing point of water, the temperature of blood at 98°, and the boiling point at 212°. Below zero the numbers run in an opposite direction and are distinguished from the ordinary degrees by a — sign before them.

Q. What other scale of graduation is used on the Continent and in America?

A. *The centigrade*, which, as its name implies, consists of 100 parts, the zero point being placed at the freezing point of water; the boiling point at the 100th. The scale is continued above and below these points; the points below zero being distinguished by a negative sign.

Q. How are Fahrenheit degrees converted into centigrade?

A. Subtract 32, multiply by 5, and divide by 9.

Q. How are centigrade degrees converted into Fahrenheit?

A. Multiply by 9, divide the product by 5, and add 32.

Q. How are *negative* centigrade degrees converted into negative Fahrenheit?

A. Thus, from the above rule: *ex. gr.* let it be required to convert 15 centigrades into degrees of Fahrenheit.

$$-15 \times \tfrac{9}{5} + 32 = -27 + 32 = +5 \text{ F.}$$

Q. Are any other fluids besides mercury used for thermometers, and why?

A. Yes; *air* and *spirits of wine* are sometimes used. The former, called *differential* thermometers, are used to measure differences of temperatures between two portions of air. The latter, the spirits of wine, are used to measure temperatures below the freezing power of mercury.

Q. Give another instance of *expansion*.

A. That of the metal in the pendulum of a clock.

Q. How is this remedied so as to preserve the regularity of the time-piece?

A. In various ways: the most simple is a rod of metal, to which, instead of a plate of metal being attached, a cylindrical glass jar of mercury is fixed upon a metal stand. When the rod is lengthened by an increase of temperature, the mercury is also expanded, and rising in the cylindrical vessel, elevates the centre of gravity, and thus compensates for the elevation or expansion of the metal rod.

Q. To what natural phenomena does the expansibility of air by heat give rise?

A. To that of the winds; more particularly the *trade winds*.

Q. Why?

A. Because the rays of the sun falling less obliquely upon the earth near the tropics, occasion the earth to be more heated there than upon any other part: this heat is imparted to the lower stratum of air in those regions, and this being expanded, rises, giving place to colder air streaming in laterally from the more temperate regions, north and south; and this in turn becoming warm, ascends, making place for another current. This successive motion in the air originates the winds, which vary in their regularity according to the part of the earth's surface in which they are found.

Q. To what practical purpose is this theory of expansion applicable?

A. To that of natural and artificial ventilation, and to the action of chimneys.

Q. How is it shown in ventilation?

A. In a mine, for instance, where ventilation is contrived by means of two shafts, or one divided down the middle; and these are so arranged, that air drawn down one shaft or channel traverses the extent of the mine below before it escapes by the other. A fire kept up in one of the shafts rarefies the air, and causes an ascending current which carries with it the impurities of the air.