IMAGE EVALUATION TEST TARGET (MT-3)

6″

CIHM/ICMH
Microfiche
Series.

CIHM/ICMH
Collection de
microfiches.

Canadian Institute for Historical Microreproductions

Institut canadien de microreproductions historiques

1980

Technical and Bibliographic Notes/Notes techniques et bibliographiques

The Institute has attempted to obtain the best original copy available for filming. Features of this copy which may be bibliographically unique, which may alter any of the images in the reproduction, or which may significantly change the usual method of filming, are checked below.

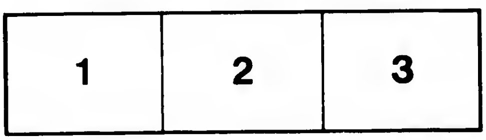
L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Les détails de cet exemplaire qui sont peut-être uniques du point de vue bibliographique, qui peuvent modifier une image reproduite, ou qui peuvent exiger une modification dans la méthode normale de filmage sont indiqués ci-dessous.

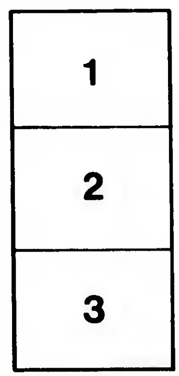
- [ ] Coloured covers/ Couverture de couleur
- [ ] Covers damaged/ Couverture endommagée
- [ ] Covers restored and/or laminated/ Couverture restaurée et/ou pelliculée
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured ink (i.e. other than blue or black)/ Encre de couleur (i.e. autre que bleue ou noire)
- [ ] Coloured plates and/or illustrations/ Planches et/ou illustrations en couleur
- [ ] Bound with other material/ Relié avec d'autres documents
- [ ] Tight binding may cause shadows or distortion along interior margin/ La reliure serrée peut causer de l'ombre ou de la distortion le long de la marge intérieure
- [ ] Blank leaves added during restoration may appear within the text. Whenever possible, these have been omitted from filming/ Il se peut que certaines pages blanches ajoutées lors d'une restauration apparaissent dans le texte, mais, lorsque cela était possible, ces pages n'ont pas été filmées.
- [ ] Additional comments:/ Commentaires supplémentaires:

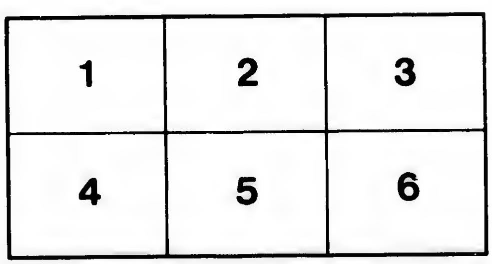
- [ ] Coloured pages/ Pages de couleur
- [x] Pages damaged/ Pages endommagées
- [ ] Pages restored and/or laminated/ Pages restaurées et/ou pelliculées
- [x] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [ ] Pages detached/ Pages détachées
- [ ] Showthrough/ Transparence
- [ ] Quality of print varies/ Qualité inégale de l'impression
- [ ] Includes supplementary material/ Comprend du matériel supplémentaire
- [ ] Only edition available/ Seule édition disponible
- [ ] Pages wholly or partially obscured by errata slips, tissues, etc., have been refilmed to ensure the best possible image/ Les pages totalement ou partiellement obscurcies par un feuillet d'errata, une pelure, etc., ont été filmées à nouveau de façon à obtenir la meilleure image possible.

This item is filmed at the reduction ratio checked below/
Ce document est filmé au taux de réduction indiqué ci-dessous.

10X		12X		14X		16X		18X		20X		22X		24X		26X		28X		30X		32X
					✓																	


1
2
3


1
2
3


1
2
3
4
5
6

Can: Lawson, George T

AGRICULTURAL TEXT-BOOK FOR SCHOOLS.

INTRODUCTION

TO

TANNER'S FIRST PRINCIPLES

OF

AGRICULTURE.

BY

PROFESSOR LAWSON, PH.D., LL.D., F.I.C.

Prescribed by the Council of Public Instruction for use in the Public Schools of Nova Scotia.

HALIFAX:
A. & W. MACKINLAY.
1880.

INTRODUCTION

INTRODUCTION.

The Art of Agriculture is based upon the Science of Chemistry. There can be no intelligent cultivation of the soil without some knowledge of the leading principles of chemical science. The acquisition of such knowledge becomes possible, and indeed easy, when the pupil is made acquainted with the peculiarities of language and the nature of the formulæ and equations employed by chemists. An acquaintance with these modes of expression is required for the purpose of conveying chemical ideas with the necessary precision, and no attempt should be made to teach chemistry without their use.

The rules for the formation of Chemical Terms and Symbols, and for the construction of formulæ and chemical equations, are exceedingly simple; and chemical language and notation, instead of interposing difficulties in the pupil's way (as is feared by many persons), on the contrary, render clear and easily comprehensible what would otherwise appear obscure and confused. This is the sole reason why they are used.

The work of the Agriculturist is to convert matter in the soil, which would otherwise be useless to man, into useful crops, and to convert the whole, or a portion, of such crops, into flesh, wool, butter, and other animal products. The processes by which these conversions are accomplished depend upon chemical laws, according to which all changes of matter take place.

Matter, or material, of whatever nature or aspect, is either (1) *Simple*, consisting of one kind and not capable of yielding any other, or (2) *Compound*, that is, made up of two or more other kinds of matter which are simple. When a substance consists of only one kind of matter, it is said to be elementary, this ultimate form of matter is called an **Element**. The number of such Elements discovered up to the present time (February, 1880,) is eighty, of which sixty-four are Metals and sixteen Non-Metallic Elements, or, as they are sometimes called, Metalloids. The metals are mostly solid bodies at ordinary temperatures, one (Mercury) is liquid, and many of them can be converted into gases by heat. Certain of the non-metallic elements, Carbon, Sulphur, Phosphorus, &c., are likewise solid, one (Bromine) is liquid, and several (Hydrogen, Oxygen, Nitrogen, Chlorine) are gaseous at ordinary temperatures. Those that are solid or liquid can mostly be converted into gases by heat, and those that are gaseous can be condensed by pressure and lowering of temperature into liquids or solids. This difference of condition, whether the elements be solid, liquid or gaseous, does not necessarily represent a chemical difference.

Chemically the Elements may exist in two conditions, (1) In the free state, (2) Chemically combined. The atmosphere consists mainly of two gaseous Elements, Nitrogen and Oxygen, mixed mechanically, in the proportion of about four parts of the former to one of the latter. When thus mixed each Element retains its own properties unimpaired except by dilution. It is quite otherwise when the Elements combine chemically.

Two or more Elements chemically combined form a *Chemical Compound*. In such a compound certain properties of the Elements composing it are no longer displayed. The Elements, when they unite, counteract each other's activities as it were, and the compound acquires properties which the elements did not possess when free. Hydrogen is a gas; Oxygen is also a gas. When these two unite, heat and light are evolved, and a compound is produced, consisting of the two gases, but quite different from both in its properties. That compound is Water, which is chemically an Oxide of Hydrogen. It is not capable either of burning or of supporting combustion, but can unite with other oxides to form new and more complex compounds. Sodium is a soft shining metal, Chlorine a suffocating gas. When they combine the resulting compound is common salt.

All the Elements have Names by which they are distinguished, and the compounds formed by their union have likewise names expressive of their composition. Sodium and Chlorine, when they combine, form, as we have seen, common salt, the chemical name for which is Sodium Chloride, that is a compound of Sodium and Chlorine. Carbon (the most familiar form of which is charcoal) combines with Oxygen in two proportions, and the two resulting compounds are called repectively Carbon Monoxide, and Carbon Dioxide, to indicate that in the first there is one atom of Oxygen, and in the second two; this latter substance was first known as fixed air, and is still often called Carbonic Acid Gas, a name given to it before our present system of chemical nomenclature was made as perfect as it now is. A compound of Oxygen and one other Element is called an Oxide, of Chlorine and one other Element a Chloride, of Sulphur and another Element a Sulphide, of Iodine and another Element an Iodide, and so in other cases.

When the Oxide of a Non-metallic Element unites with water it forms *an acid*, that is a compound which has a sour taste and reddens litmus. When the Oxide of a metal combines with water on the other hand it forms *an alkali*, turning the red litmus blue.

When two such compounds, an alkali and acid, are brought together, their oxides unite, and a more complex compound is formed, which is neither acid nor alkaline, but neutral; it is usually soluble and crystallizable, and is called *A Salt*. Many of the compounds contained in the soil, in manures, and in food, are salts, or are built up in the same way. Land Plaster is Oxide of Calcium (Lime) combined with Sulphuric

Oxide, and is hence called Calcium Sulphate, by the Chemist; the same Oxide united with Carbon Dioxide forms Calcium Carbonate, common limestone or chalk. If the Carbon Dioxide be driven off from this latter by heat the Calcium Oxide remains as burnt lime; when water is now added it combines with the Oxide and forms the Alkaline Hydrate. Calcium Oxide united with Phosphoric Oxide forms Calcium Phosphate or Phosphate of Lime. Clay consists essentially of Aluminium Oxide and Silicic Oxide, that is Aluminium Silicate, which, altho' it corresponds to a salt in composition, is, like many other Silicates, not soluble in water.

The Elements when in union with each other always so exist in definite proportions by weight and volume. They unite (with very few exceptions) in equal volumes compared in the gaseous state. But the volume or atomic proportion, although always constant in weight for the same element, is different in weight for the different elements. One volume or atomic proportion of Hydrogen (which is the lightest element) is reckoned as weighing 1, and a volume or atomic proportion of Oxygen weighs 16, one of N. 14, one of Sulphur 32; these are the atomic weights of the elements respectively. Each element has a definite atomic weight.

As the atomic proportion or "atom" of an element has a definite weight, so a compound also has its definite or molecular weight. Two atoms or volumes of Hydrogen, weighing 1 each, unite with one atom or volume of Oxygen, weighing 16, to form one molecule of Water weighing 18. The molecular weight of a compound is the sum of the atomic weights of its constituents.

In Chemical Notation every element is indicated by a *Symbol*, which consists, in most cases, of the initial letter of the name of the element, as C for Carbon; where two or more elements have the same initial letter, an additional distinctive letter is added when necessary, as Cl for Chlorine. The symbol stands for one atomic proportion, that is one volume or "atom," of the element; this is multiplied by placing a small figure on the right hand side of the symbol, thus, Cl_2.

A *Formula* is simply formed by placing two or more symbols together, to show the elements of which a compound consists. Thus H_2O is the formula for Water, showing that this compound consists of two volumes of Hydrogen and one volume of Oxygen; as the atomic weight, or weight of one volume, of Hydrogen is 1, the two atoms will weigh 2, and as the atomic weight of Oxygen is 16, its one volume will weigh 16;—the formula thus represents to us the exact proportions by volume and weight of the elements of which the compound consists. The use of a chemical formula is to show the precise composition of a compound body.

A *Chemical Equation* consists of two or more formulæ, or of at least one formula and two or more symbols; its object is to represent what is called a "reaction," that is a change in the constitution, or arrangement of the components, of a compound, or the formation from free elements of a compound, or the resolution of a compound more or less completely into its elements. Thus, if we place a piece of the element Sodium in contact with the compound Water, a chemical change takes place: the sodium and water have combined to form an alkali, but not the whole of the water, for a gas, H, is set free. The change is explained by the following "equation:"—

$$2\,H_2O + Na_2 = 2\,NaOH + H_2$$

Which we may read thus: two molecules of Hydrogen Oxide (water) and two atoms of Sodium, *yield* two molecules of Sodium Hydrate and two atoms of Hydrogen. In every case where the algebraic sign of equality = is used in a chemical equation it is to be read, not as "equal to," (which would suppress the essential idea sought to be conveyed), but as "*yields*" or "*yield*" so and so. For examples of chemical formulæ and equations, see foot notes on pages 35, 36, 37.

List of some Chemical Compounds mentioned in this work, with their formulæ.

Water .... H_2O
Silica (quartz, sand) .... $Si\ O_2$
Silicic Acid .... $2H_2O, Si\ O_2$ or $H_4\ Si\ O_4$
Carbon Dioxide (Carbonic Acid Gas) .... CO_2
Sulphuric Acid (Oil of Vitriol) .... $H_2\ SO_4$
Phosphoric Oxide (Anhydride) .... P_2O_5
Phosphoric Acid .... $3H_2O$, P_2O_5, or H_3PO_4
Calcium Oxide (burnt lime) .... CaO
Calcium Hydrate (slacked lime) .. CaO, H_2O or CaH_2O_2
Potassium Oxide .... K_2O
Potassium Hydrate .... K_2O, H_2O or KHO
Sodium Oxide .... Na_2O
Ammonia .... NH_3
Ferrie Oxide .... Fe_2O_3
Sodium Chloride (common salt) .... $NaCl$
Calcium Carbonate (marble, limestone)
CaO, CO_2 or $CaCO_3$
Potassium Nitrate (Saltpetre) .. K_2O, N_2O_5 or KNO_3
Calcium Sulphate (Plaster, anhydrous)
CaO, SO_3 or $Ca\ SO_4$
Tri-Calcic Phosphate (bone earth)
$3CaO$, P_2O_5 or $Ca_3P_2O_8$
Bi-Calcic Phosphate (Reduced Phosphate)
$2CaO\ H_2O$, P_2O_5 or Ca_2H_2, $2\ PO_4$
Mono-Calcic Phosphate (Superphosphate)
CaO, $2\ H_2O$, P_2O_5 or $Ca\ H_4$, $2\ P\ O_4$
Aluminium Silicate, hydrated, (Silicate of Alumina, Clay) .... Al_2O_3, $2Si\ O_2$, $2H_2O$
Aluminium and Potassium Silicate (Double Silicate of Alumina and Potash) .... K_2O, Al_2O_3, $6\ SiO_2$

80