Agricultural Chemistry.

II. WATER.—*Continued.*

In the last number of the Canada Farmer, we described the way in which water can be decomposed into two gases, oxygen and hydrogen, and we then gave a short account of the first of these gases and its relation to animal and plant life. We will now consider the other constituent of water, hydrogen. One way of procuring this gas, we described in our last paper while speaking of the decomposition of water by means of a galvanic current. Red hot iron will decompose water in the same way, but hydrogen is usually procured by acting on water and sulphuric acid with zinc or iron. A bottle is furnished with a cork perforated by a bent glass tube, and into it are placed scraps of zinc, water is poured on the zinc, and sulphuric acid added till a brisk effervescence indicates that the hydrogen is escaping. It may be collected over water in the same way as oxygen

Sulphuric acid, or as it is commonly called *oil of vitriol*, consists of hydrogen combined with oxygen and sulphur. When it is brought into contact with zinc, the zinc displaces the hydrogen and forms a compound of zinc, oxygen, and sulphur which is known as sulphate of zinc, the hydrogen at the same time escaping as a gas. The sulphate of zinc remains dissolved in the water, from which it may be obtained by evaporation in colorless crystals If iron were used instead of zinc, sulphate of iron, or *green vitriol*, would be formed in place of sulphate of zinc.

Hydrogen, like oxygen, resembles common air in having neither color, taste, nor smell. It is the lightest substance known, being only one-fifteenth as heavy as air, and only one-sixteenth of the weight of an equal bulk of oxygen. Hydrogen will take fire on the application of a light, and burn with a pale flame. This flame, although it gives very little light, is very hot. A mixture of hydrogen and oxygen will explode with considerable violence if brought in contact with flame. The explosion is caused by the two gases uniting together to form water, If the mixture contains two volumes of hydrogen and one of oxygen, it will be entirely converted into water, and both gases will disappear altogether. It will be remembered that when water was decomposed by the galvanic current the gases were evolved in these proportions. Hence we see that water is composed of oxygen and hydrogen united, in the proportion of one volume of the former to two of the latter; and, as oxygen weighs 16 times as much as an equal bulk of hydrogen, the composition of water *by weight* will be 16 parts of oxygen and 2 parts of hydrogen. In other words 9 pounds of water will contain 8 pounds of oxygen and 1 pound of hydrogen.

When hydrogen burns in the air, water is produced by the combination of the hydrogen with the oxygen of the air. The formation of water in this way may be shown by allowing the hydrogen to escape from the bottle, in which it is being generated through a tube drawn out to a fine point and setting fire to the jet of gas as it issues from the tube.

The hydrogen will burn with a small pale flame, and if a cool glass be inverted over the flame, drops of water will be deposited like dew over its inner surface. If hydrogen is mixed with air, it will explode on contact with a lighted match, but as air only contains about one-fifth of its volume of oxygen, the explosion is not so violent, and a larger quantity of air has to be employed than the quantity of oxygen which will suffice to explode the hydrogen.

In order to understand the manner in which these two gases unite to form water, it will be necessary to say a few words about the constitution of matter in general. We look upon matter as being made up of particles so small as to be entirely beyond the reach of our senses. To these particles we give the name of *atoms*, a name which signifies that they cannot, so far as we know, be divided. Elementary bodies are made up of atoms of one kind. Compound bodies, on the other hand, consist of two or more kinds of atoms united together chemically. Thus oxygen is made up entirely of atoms of one kind, and hydrogen is made up of atoms of another kind, but water consists of *one atom of oxygen united with two of hydrogen.* The atoms of the various elementary substances differ in weight. The atom of oxygen weighs 16 times as much as the atom of hydrogen, and hence water must contain 16 parts by weight of oxygen and two parts by weight of hydrogen. Again, equal volumes of elementary gases always contain an equal number of atoms. Hence two volumes of hydrogen and one of oxygen unite to form water which contains two atoms of hydrogen and one of oxygen. These atoms, for the sake of shortness, are represented by symbols. Thus O represents one atom of oxygen, and H represents one atom of hydrogen. Water, which consists of one atom of oxygen and two of hydrogen, is represented by the *formula* H_2O. The symbol O also stands for 16 parts by weight of oxygen, and the symbol H stands for 1 part by weight of hydrogen. As hydrogen is the lightest substance known, the weights of the other atoms are all compared with the weight of one atom of hydrogen. The numbers which express the weight of the atoms of the elementary bodies compared with the weight of one atom of hydrogen are called their *atomic weights*. The formula of water, H_2O, signifies that water contains two parts by weight of hydrogen and sixteen parts by weight of oxygen.

Pure water contains nothing beside hydrogen and oxygen, but water from natural sources is never pure. Rain water always contains certain gases dissolved in it, which it absorbed in falling through the air. These gases are nitrogen, oxygen and carbonic acid. They may be expelled by boiling. Well, spring and river waters contain, in addition to these gases, a variable amount of solid matters obtained from the soil and from the rocks over which they pass, such as various salts of soda, lime, and magnesia, and also more or less *organic* matter, derived from decomposing vegetable and animal substances. The presence of the salts of lime and magnesia confer upon water the property of *hardness.*

Soap consists of a fatty acid combined with an alkali. Salts of lime and magnesia decompose soap, the fatty acid uniting with the lime or magnesia and forming the curdy flakes which are always formed when soap is used for washing in hard water. Hardness is of two kinds—*temporary* and *permanent*. Temporary hardness is caused by the presence of carbonate of lime. This salt is insoluble in pure water, but dissolves in water which contains carbonic acid. When water is boiled, the carbonic acid is, as we have seen, expelled, and the carbonate of lime falls down as a sediment, leaving the water soft. The addition of more lime, which unites with the free carbonic acid to form carbonate of lime, produces the same effect. Thus, water whose hardness is due to the presence of lime may be sometimes made soft by the addition of more lime. Sulphate of lime renders water permanently hard. Such water cannot be softened by boiling. The addition of carbonate of soda (washing soda), however, removes the hardness in this case as well as the other, by decomposing the salts of lime and magnesia, forming carbonates which are insoluble in water.

A correspondent writes to the *Country Gentleman* strongly urging one or other of the following mixtures as manure for potatoes:—1. One part salt, two parts plaster and four parts of unleached ashes. 2. One part salt, two part plaster, three parts lime and four parts of ashes; mix thoroughly and apply a tablespoonful on, or with the seed at the time of planting. Plaster (gypsum) alone is excellent as a top top-dressing. Ashes alone are always good for any crop, and and potatoes want nothing better—the trouble is to get enough of them.

Entomological Department.

ENTOMOLOGY, PAST AND FUTURE.

It has not been the practice of the Editor of the Entomological Department to "sound his own trumpet" in these columns, or to make much allusion to his own performances; nor indeed can we think that any of the editorial staff of the Canada Farmer have been deficient in that virtue of modesty which is said always to accompany true merit. We trust then, that the reader will pardon in the writer any seeming departure from a fitting abnegation of self on the present occasion, as it is the first and will probably be the last time, when he will inflict upon those who take an interest in this department any prominent putting forward of his own personality. As, however, this publication is entering upon a new phase of existence, with brighter prospects and higher aspirations for the future, we deem it not out of place to say a few words upon what we have done in the past, and what we hope to be able to accomplish in the time to come.

Nearly eight years have gone by since the writer first became connected with the periodical, and commenced his contributions upon Entomological subjects. Since that time, with the exception of the closing months of last year, his department has been maintained with more or less regularity and fullness, and has been the evident means of attracting great and general attention to the importance of a thorough scientific knowledge of our insect friends and foes. So marked, indeed, has been the influence of this work upon the public mind, that it has not only developed a popular interest in the subject throughout the Province, but has been instrumental to no slight extent in causing the legislature to devote an annual grant to the Entomological Society, and to cause a report to be published yearly upon the noxious and beneficial insects of the country.

In looking over the back volumes of the Canada Farmer, we observe that the first notice that appeared in this country, the first too, as far as we know, that appeared in America, of the gooseberry and currant saw-fly (*nematus ventricosus*), that most destructive pest, was a long article by the editor of this department, in August 1865. Again we observe that we were the first to draw public attention in the spring of 1870, to the expected invasion of the country by the Colorado Potato Beetle, which duly happened in the following summer; and the first to give to the farmers of Canada reliable illustrations of the insect, and information respecting its habits and the best modes of dealing with it. Another matter upon which we pride ourselves is that we believe we have completely killed out by reason and ridicule, though at the risk of a libel suit! the absurd superstition that the tomato-worm is a frightfully poisonous creature, and the destroyer of many human lives annually! We do not like to feel too sure of our success in this respect, but as a whole season has gone by without a single startling paragraph on the subject, in any Canadian newspaper, we fancy that our efforts have not been in vain. Apart from these special topics, however, no one can refer to the past eight volumes of the Canada Farmer, without finding a vast mass of information respecting insects of almost every kind, destructive, beneficial, curious, innoxious, or neutral, affecting the field-crops, the fruit-trees, the vegetables, the flowers, the house-plants, the forest, acting as parasites, as scavengers, as fertilizers of plants, as plagues, as blessings, in short, insects have been treated of in all their relations to mankind, in all their states and stages of existence.

But though so much has been done, the field is so vast, the number and variety of these creatures is so enormous, that the work can never be brought to completion. As long as the world lasts there will always be something more to learn, something fresh to relate about these ubiquitous creatures. Every year, indeed, we seem to hear of some fresh plague, some new insect foe, that had not troubled us before. We have lately had the arrival in the west of the Colorado beetle, and in the east of the English cabbage butterfly; while now from the south we are threatened with the asparagus beetle. Each crop in turn seems to be the object of some new work of the destroyers, and no sooner are we finished with one, than a new combat has to be entered upon. Such being the case, the necessity and the value of this department of our journal, are in no wise diminished by the amount of work that has already been performed in it, but it continues as important as ever, and requires