

NATURE STUDY AND SCIENCE.

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Chemistry in the High Schools.

Judging by the papers written at the matriculation and high school leaving examinations in New Brunswick, it is evident that in some schools chemistry is carefully and systematically taught by the laboratory method. Many of the pupils have performed most of the experiments with their own hands, and have learned the chemical reactions involved.

But there is a tendency to employ the experiments merely to *illustrate* the lesson—to aid the *memory* in retaining chemical formulas and equations—and not as a means of training the observing and reasoning faculties of the pupils, while they, at the same time, are gaining a knowledge of elementary chemistry. This is a great educational loss without any compensating gain.

Let me explain my meaning with the help of some of the questions given in the departmental examinations for 1901.

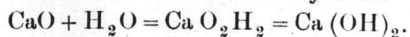
Deduce (reason out) and then equate the reactions which occur when lime is treated with water and the product mixed with a solution of hydrochloric acid.

Lime is used so largely in various manufacturing processes—in building and in agriculture—that a knowledge of its chemical properties should be of interest to all. An intelligent candidate who has been well taught would probably take, in answering the above questions, such a line as this:

We know that lime, since it lacks the metallic lustre and other distinctive properties of the metals, is not a *metal*; but chemists have found that it is the oxide of the metal *calcium*, and give CaO as its formula. When a piece of lime is treated with cold water, much heat is produced, and the water rapidly disappears. The dry product thus obtained we find to be heavier than the original lime; and if some of it be heated in a closed tube water collects above it, and a white substance, resembling powdered lime, remains in the bottom of the tube. We, therefore, conclude that the water must have disappeared by uniting chemically with the lime, thus increasing the weight—that the heat was produced by this union—and that the soft, dry, white product is composed of the elements of lime and water—Ca, H, and O, and is properly named *calcium hydrate*, the chemical formula for which, as given by chemists, is $\text{Ca}(\text{OH})_2$.

The reaction, then, would be equated thus:

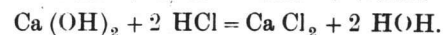
Lime + Water = Calcium Hydrate.



We find that $\text{Ca}(\text{OH})_2$ has an alkaline taste, and that its solution (lime-water) turns red litmus blue. Besides, it is a compound of a metal and OH. It is therefore a base.

Now we have noticed before that when a base and an acid are mixed the metal of the base took the place of the H of the acid, and that the displaced H united with the OH of the base to form water, HOH. Hence I conclude that when $\text{Ca}(\text{OH})_2$ is treated with the acid HCl, a similar reaction follows. As the valence of Ca is two and of H one, one molecule of the base would react with two of the acid, thus:

Base + Acid = Salt + Water.



Deduce and equate a reaction which will yield chlorine, or one which will yield calcium sulphate.

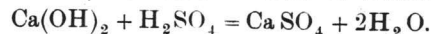
The reaction for chlorine can be reasoned out like the preceding reactions, but in fewer words, by a candidate who has watched the experiment (given in the text-book) performed by the teacher, and has carefully considered the theoretical and qualitative proofs of the correctness of the equation.

But suppose the second reaction is chosen, the following argument might be given:

Calcium sulphate, since it consists of the metal Ca in union with the negative radical SO_4 (the sulphate radical) is a salt. Now we have noticed in other cases that when a base and an acid are mixed a salt is produced by the metal of the base changing places with the H of the acid. A base consists of a metal and OH; so the base of calcium sulphate would be $\text{Ca}(\text{OH})_2$. The acid of a salt consists of H united with the negative part of the salt; so the acid of this salt would be H_2SO_4 . As Ca and SO_4 are bivalent, one atom of the former would probably unite with one of the latter.

Hence the reaction would be:

Base + Acid = Salt + Water.



Other points in regard to the teaching of high school chemistry will be discussed in the next number of the REVIEW.

Questions for December.

(Answers should be sent to editor of this department by January 15, 1902. Several new schools began to send answers last month. The editor hopes they will continue their efforts. Their answers will be duly examined, and reported on in June next.)

1. Find, by watching some convenient branches, whether deciduous trees grow any in winter, and whether evergreen trees do. Give proofs.

2. Find a leafless tree whose branches spread out widely and nearly horizontally from the main trunk which runs up through the middle of the tree to the