

If you used zinc, you will have a sulphate of zinc; if you employed iron, you will have sulphate of iron. One day spent in experimenting in this way at the cost of a few cents, will have a better impression than a week of study could possibly do without it.

No. 12.—Compounds of Hydrogen.

We have now examined three elements,—oxygen, nitrogen and hydrogen—and consequently are prepared to notice the compounds formed from them.

If you should burn some hydrogen gas in the air, the oxygen of the air would combine with the hydrogen; but would it be destroyed? That is impossible. We may change the forms of bodies, but we cannot destroy the elements of which they are composed. This fact must be kept constantly in view. If now by combustion we combine one pound of hydrogen with eight pounds of oxygen, we have a compound of nine pounds water;—a result the most remarkable, that by *burning* two substances we should *produce* a substance which is the greatest enemy to combustion. But such is the fact, that water is produced by the combustion of bodies.

The union of two or more elements to form a compound is called synthesis; the separation of a compound into its elements is called analysis. We have just shown how water may be formed by synthesis. If we should pour some water into a bottle containing granulated zinc, the oxygen of the water would slowly combine with the zinc, forming an oxide of zinc, while the hydrogen having nothing with which to combine would escape in the form of a gas. This is a case of analysis. You can now understand why a piece of iron rusts when left in water. The oxygen of the water combines with the iron and forms an oxide of iron, which we commonly call iron rust. Water parts with its oxygen so easily that most of the metals form oxide in this way. Gold, silver, and platinum are exceptions, hence their use for coin, and the name of the *noble* metals which is applied to them.

You are familiar with many of the properties of water so that we need not repeat them. It evaporates at all temperatures. A constant stream of water is going up from the surface of the earth during the day, it is deposited in the form of dew, frost or rain. It enters into the composition of the sap of vegetables. There is one curious thing which is very common, but yet seldom noticed, and that is, its form of crystallization, which is shown in snow, frost and ice. A single crystal of snow is a six-sided prism; but we generally see several of these crystals grouped together, more commonly in a star-shaped form. Hundreds of forms of these grouped crystals may sometimes be seen in a single snow-storm. When the air is still, and the snow falls very gently, you may often see these crystals by letting them drop on your sleeve or on any dark object. The crystals of frost on your windows all form at a certain angle. Ice is only crystallized water, which causes it to be lighter than water and to float on its surface. Pure water does not exist on the surface of the earth. It dissolves some of the earths and salts from the earth. It also has a portion of air and carbonic acid air dissolved in it, which renders

it palatable as a drink. If you boil water you drive off the air and carbonic acid and it is unpleasant as a beverage. It is only by distillation in glass vessels that water can be obtained in a pure state.

You may be surprised to know that water will dissolve a greater variety of substances than any other known fluid. Most persons know that water will not dissolve camphor, and that alcohol will, and hence infer that alcohol has greater solvent powers than water, but it is far otherwise. Alcohol will not dissolve the various gums at all, but water will. On the other hand, alcohol will dissolve the resins, which water will not. Hot water, especially if potash or soda be dissolved in it, will dissolve many substances better than pure cold water. The hot springs found in Arkansas will dissolve sand. We have lying before us a specimen of moss from these springs, all covered with silicious matter which had been held in solution.

It not only has great solvent power, but has the power of combining with many substances with great energy. These compounds are called hydrates. If you pour a pailful of water on a cask of quick-lime it will immediately combine with the lime and form a compound. You will not see a drop of the water in a few minutes. Here is an example of a liquid combining with a solid. This compound is called the hydrate of lime. Water will combine in the same way with caustic potash. You have seen a rusty looking substance in the water by the road-side. Well that is oxide of iron and water. We call it the hydrate of the peroxide of iron. Most of the salts contain a portion of water in a solid state. Plaster of Paris contains about twenty-one per cent. of water.

There is a pretty experiment which you can perform for five cents. Dissolve Glauber salts in boiling water as much as it will hold, and put it while hot into a two-ounce vial and cork it up and set it away where it will cool and be undisturbed till the next day. Then take it carefully down and uncork it, and touch the point of your pen-knife in it and it will instantly form into a crystalline mass. The water has suddenly been changed into a solid. This is called the water of crystallization.

Mild as it appears to us, it is nevertheless essential to the energy of sulphuric, phosphoric, and nitric acids, with which it is combined.

Such are some of the properties of water. It plays an important part in the history of the globe. It forms the waters of the ocean, which holds in solution all the other elements, and without it man must cease to exist.

No. 13.—Compounds of Hydrogen Ammonia.

Among the many interesting compounds, and one which especially interests the farmer is that of ammonia. It is composed of three parts of hydrogen and one of nitrogen. If you should mix in a vessel one pound of nitrogen gas with three pounds of hydrogen gas, they would not unite so as to form the compound which we call ammonia, but they would still remain as mixed gases. If now you should pass through this mixture a series of sparks from an electrical machine, they would cause a union of a limited portion of the gases and produce am-