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(From the *Main Farmer.*)

No. 4.—Crystallography.

Among the curious things that meet our eyes every day, is the fact that many substances in nature assume a regular form. Thus, if you look at a mass of course salt, you will find the pieces in blocks or cubes. Thus, common salt crystalizes in the form of a cube, while saltpetre crystalizes in the form of a six sided prism. If you should take a crystal of common salt as large as the end of your thumb, and break it into a hundred pieces, each one of the fragments would have the same shape—that of a cube, showing that the internal structure of the crystal was regular throughout. Thus, we may now give you a definition of a crystal. A crystal is a substance having an internal regular structure, to which is sometimes super-added a regular external form. It is the tendency of the particles of all bodies, when left free to move among themselves, to assume a regular form. This tendency is not confined to mineral substances, for we see the same symmetry of form in plants and animals.

In plants and animals whose substances are under the control of the vital principle, their outlines are generally curved or rounded in form, while inanimate matter assumes plane surfaces and an angular form. This is the case with all mineral substances. Animal matter is an unstable compound, formed by assimilating materials within itself, and soon decaying when its elements are separated. A crystal, on the other hand, when once formed, is never destroyed, unless acted upon by external influences. Crystals that were made many thousand years ago, still remain the same where shut up among rocks. The moment a crystal begins to form, no matter how small it may be, it is a perfect crystal. A crystal of common salt no larger than the head of a pin, is a perfect cube. but if left in a solution of salt in water, particles of salt will be added to the different sides of the cube until it may be an inch in diameter. This is the way then that a crystal increases in size, by additions to sides. Thus, animal and vegetable growth is internal, while that of the crystal is external.

The same substance usually crystallizes in the same form, so that we generally determine the substance by its crystalline structure. Thus, common salt crystallizes in the form of a cube. So does iron pyrites, or *fool's* gold. Saltpetre on the other hand, crystallizes in the form of a long, slender crystal, having six sides. Common quartz crystallizes in six sided prisms, terminated by a six sided pyramid. Epsom salts crystallizes in four sided prisms, while alum crystallizes in the form of an octahedron, like the diamond, which also crystallizes in this form; hence alum crystals were formerly called *alum* diamonds to distinguish them from the real gem. A knowledge of these different forms enable us, frequently, to distinguish such salts as are harmless from those which are poisonous. Epsom salts resemble oxalic acid, the latter a fatal poison, but it may be distinguished from it by its different form of crystallization. It is by the form of the crystal that the chemist readily distinguishes between the different kinds of salts and minerals that constantly present themselves to him.

No chemist has yet been able to tell us with certainty what is the shape of the atoms of bodies, but it has been inferred from the shape in which crystals are formed, that they are composed of three different forms, the *spherical* atoms which serve to make a cube and other similar forms, the *spheroidal*, for the square prisms, and the *ellipsoidal* for other forms. The different geometrical forms of crystals are very great. Those of carbonate of lime alone number more than six hundred secondary forms.

In order to make a regular crystal, it is necessary that the substance be in a liquid or gaseous condition, so that the particles can move freely among themselves. Sometimes we may make crystals by melting a substance and then cooling it. You can perform a pretty experiment with sulphur. Fill a teacup with sulphur or roll brimstone, and melt it and set it away to cool till a crust is formed over the surface. When you break through the crust and pour out the portion not yet cooled, there will sheet out on the inside of the cavity, beautiful crystals of sulphur. Gently heat the cup again so as to detach the whole mass from it, and carefully break it in two parts, and you have a beautiful specimen of crystalized sulphur in long, slender prisms. But we will wait till another week before we tell you all we have to say about crystals.

No. 5.—Crystallography Continued.

Among the most familar crystalline substances is common salt. We have already shown that its form is that of a cube, but there is a peculiar shape which it sometimes takes, known as the hopper-shaped crystal. When you evaporate salt water very slowly and in a quiet position, regular cubes will be formed, but if you evaporate it rapidly or agitate it, the salt will be in the form of irregular crystalline grains; salt obtained by rapid evaporation in boilers appears in this way. When the liquid is quiet and evaporating slowly, little cubes will form on the surface of the water and unite together forming one crystal, which gradually sinks and enlarges as it descends till it forms the hopper-shaped crystal. You can pick them out of almost any coarse salt bin.

Sometimes you may make crystals by just changing a solid or liquid to a gaseous state, and then allowing it to cool. Take two or three grains of iodine, put them into a glass vessel,—a Florence flask is the best,—and apply the gentle heat of a lamp, when a beautiful violet vapor will arise and fill the vessel, which on cooling will be precipitated on the sides of the vessel in small, dark colored crystals. Solid camphor will evaporate in a glass jar and then crystallize on its sides. Sulphur and arsenic will crystallize on the sides of a vessel in the same way. It is said that on a certain occasion at an eruption of a volcano, the lava run through a church, when the sulphurous vapor arose and crystallized upon the ceiling of the church.

The vapor of water or from the breath which lodges on a cold window assumes a crystalline form. However fantastically they may appear, they are all governed by the same law, and arranged against each other at the same angle. In this way snow crystallizes in a great variety of forms. When the snow falls very quietly you may collect them on a smooth surface and examine them with the naked