THE WAY TREES GROW.

At the last meeting of the Farmers Club, Mr. Bartlett, being called on by the President, made the following report:—

Mr. Chairman, The committee to whom was referred the communication of S. Crosby, respectfully report. The several queries in that communication constitute a request for a general account of the circulation of sap in trees, and the formation of maple sugar. We proceed to give such an account in the briefest and clearest manner at our command.

Trees are made up of fine tubes which extend from the root to the leaf, and it is through these tubes that the circulation of the sap is carried on. If a growing tree is pulled up by the roots, and the roots are placed in a vessel of water containing some colored solution which they will absorb, we can trace the course of this colored solution through the tree by cutting notches into it at successive periods. The coloring matter is always found first in the body of the wood near the root, then in the wood higher up, and so on until it reaches the leaf; then it begins to appear in the inner bark near the leaf, and it passes down through the bark again to the root. This observation shows that the circulation of the sap is up through the wood, and down through the bark.

We are not able to answer the question of your correspondent, what is the force that causes the sap of plants to circulate. There has been much speculation in relation to it, but it has never been settled by observation and experiment. It is pretty well established that sap circulates in the winter, though less rapidly than in the summer, and less rapidly at that time in deciduous than in evergreen trees.

THE FORMATION OF SUGAR IN THE MAPLE.

The solid portions of thoroughly dried wood, and other parts of plants, are composed mainly of water and charcoal. When charcoal is burned, a small portion of ash is left. This ash is the mineral or inorganic portion of the substance of the tree, and consists principally of potash, lime, and flint or silex. That portion which burns is carbon. In burning, the carbon unites with oxygen to form carbonic acid, an invisible gas that floats away in the atmosphere.

The water and the inorganic matters enter the tree through the roots; the carbon enters mostly through the leaves. Carbon forms about one half of the solid substance of the tree, and water the other half.

Water is composed of two elements, oxygen and hydrogen, in the proportion of eight pounds of oxygen to one of hydrogen. These in entering into a chemical combination with carbon, lose the liquid state of water, and form the various solid substances which make up the body of the tree.

In its course the sap undergoes important transformations. The trunks and leaves of trees are scenes of constant chemical operations, many of them more mysterious than any of the operations of the labratory. One of these is the decomposition of carbonic acid in the leaf. The affinity of carbon and oxygen is very strong indeed, and there are few forces in nature that can rend these two elements asunder; but the combined action of light and vegetable life is separating them throughout every day in the leaves of all growing plants. Carbonic acid is absorbed from the atmosphere by the leaf, its two elements are torn apart, the oxygen is returned to the air, and the carbon combining chemically with other elements in the sap is carried to the places where new wood is being formed, and is there deposited in its proper place to help build up the structure of the tree. The symmetrical order in which the carbon is deposited in a tree may be seen by looking at a piece of charcoal.

If wood is examined under a powerful microscope, it is found that the tubes through which the sap circulates are formed of minute sacs or cells. The substance of which the walls of these cells are formed is called cellulose. It has been the subject of a great deal of chemical research, and is found to consist of carbon and water, or more strictly, of carbon and the elements of water, oxygen and hydrogen. Cotton and linen are almost pure cellulose. Each atom of cellulose contains 12 atoms of carbon, 10 atoms of hydrogen and 10 of oxygen, $C_{12}H_{10}O_{10}$. Starch, gum, and sugar all have the same composition $C_{12}H_{10}O_{10}$. This is one of the wonders of chemistry, that substances composed of the same elements, combined in the same proportion, should have properties so different as gum, starch, sugar, and cotton or linen fiber. Their different properties must of course result from the different modes in which the atoms are arranged.

Besides these four substances there is one other constituting a considerable portion of the body of trees, which is also formed of the same elements as the others but in slightly different proportions. This is lignin. It is an incrustation on the inner surfaces of the cell walls, and its office appears to be to strengthen and stiffen these walls. Its constitution is $C_{12}H_8O_8$. In this case, as in the others, there are just as many atoms of hydrogen as of oxygen; these two elements enter into the compound in the same proportion to each other as that in which they unite to form water. If a tree or other plant is thoroughly dried so as to expel all of its uncombined water, nine-tenths of the remaining substance consists of the five compounds, cellulose, lignin, starch, gum, and sugar, and all of these are composed of hydrogen and oxygen in the same relative proportion as that in which they exist in water, chemically combined with carbon.

Why it is that the atoms of these substances are so arranged in one part of the plant to form cellulose, and in another to form starch; why it is that they are so arranged in one tree as to form gum, and in another to form sugar, are mysteries which lie beyond the present boundaries of human knowledge.

There is one other organic element, and several inorganic, besides those mentioned, which enter, though in small quantities, into the constitution of plants, but a full discussion of the part which they perform in vegetable economy would demand an exhaustive treatise on agricultural chemistry and vegetable physiology. The presentation of this general view of the growth of plants is deemed the most proper discharge of the duties of your committee.

POLYTECHNIC ASSOCIATION OF THE AMERICAN INSTITUTE.

The Association held its regular weekly meeting at its room at the Cooper Institute on Thursday evening Oct. 13, 1864, the President, D. S. Tillman, Esq., in the chair. The regular subject of the evening was

THE PNEUMATIC RAILWAY.

Mr. Garvey, the Secretary, read from the London *Railway News* a description of the railway now in operation at Sydenham, England, substantially the same as that already published in the Scientific American. The *News* pronounced this experiment a success, and this mode of traveling agreeable as well as rapid.

The President:—It is stated that the average pressure on the piston is 2½ ounces per square inch. The size of the tube is not given, but supposing it 10×10 feet=100 square feet, at 22 pounds per foot=2,200 lbs. on the piston. The tunnel is 1,800 feet long; so the solid contents would be 180,000 cubic feet, and the whole of this air would have to be rarified to produce the pressure. The fringe packing, so far as that goes, is good.

Mr. Roosevelt:—Mr. President, as I proposed this question it will be expected that I should say something upon it. It seems to me that it is the perfection of all modes of travel; that when this is introduced we cannot hope for, or imagine, anything better. It is especially adapted for crossing the rivers out of this city in place of ferry-boats. With tubes, either under the water or over, we can cross very quickly, at any minute, without any delay from ice or other obstructions, and in perfect safety. I hope those who have given more attention to the details of the subject than I have will give us their views.

Mr. Fisher:—I understand, Mr. President, that the scheme of a subterranean railway under Broadway is to be pushed this winter, and efforts are to be made to obtain a charter from the legislature. It will be remembered that when this scheme was discussed some years ago here, I expressed the opinion that the smoke, steam, and gas from the locomotive would make the tunnel unendurable to the passengers. I hold in my hand a letter from the London correspondent of the *New York Herald*, in which he speaks of the tunnel in the subterranean railway in London, where locomotives are used. He says that a number of persons have been taken out in an unconscious state, being nearly deprived of life from the carbonic acid coming from the furnace of the locomotive. A number of the employes of the company have also been prostrated, and it is found impossible for any person to work in the tunnel for any considerable length of time. The numbers of passengers on this road are constantly diminishing. On the other hand, the writer says the pneumatic tube is the delight of all who have tried it. The ventilation is perfect, and the air is remarkably fresh and pure.

Perhaps the high velocity obtainable by the pneumatic tube may bring it into use, but I do not think we are quite ready for it yet. I do not think it is adapted for travel through the streets of cities. The time and power required for getting up such high velocities, and the time required to stop a car when moving so rapidly, render this mode of locomotion unsuitable for street conveyance. A railroad car running 60 miles an hour will run 3 miles after the power is cut off before it will stop.

Dr. Parmelee:—I have examined the air guns in use in the rifle galleries in this city, and I find that the bullet is packed by a fringe analogous to the bristles around the piston in this pneumatic tube. Many other plans have been tried, but this has received the preference.

FARMERS' CLUB.

The Farmers' Club of the American Institute held its regular weekly meeting at its Room at the Cooper Institute, on Tuesday afternoon, Oct. 11, the President, N. C. Ely, Esq., in the chair. From the varied discussion we present only the following:—

PRESERVING CIDER.

Mr. Robinson:—I have here an inquiry if there is any mode of keeping cider sweet except the use of sulphite of lime. The writer says that injures the flavor.

The President:—Cider and wine may be purified by isinglass. Dissolve isinglass in warm water, stir it gently with the wine, let it settle, and then carefully draw off the liquor. You may use about an ounce of isinglass to a gallon of cider. I purified wine in this way thirty years ago. The process takes out some of the fruity flavor of the liquor. It is better to let it settle without the isinglass. "Wine on the lees" is the best now as it was in Scripture times.

Mr. Carpenter:—The main, thing, Mr. Chairman, in keeping cider is to have the barrel clean and sweet, and the cider free from pomace and other impurities.

Mr. Hillsboro:—The best barrel of cider that I ever saw had a handful of alum put into it in November. It did not remain sweet, but the next summer it was a most delicious drink.

A report on the way trees grow was also read and will be found in another place.

The Money Order System.

The postal money order system is to go into effect upon Nov. 1st. This plan is for the transmission of small sums, not less than one dollar and not more than thirty dollars. For the service to the parties interested the following fees or commissions are to be paid in advance by the party who deposits the money. For orders for sums of ten dollars and under, ten cents; over ten dollars and not exceeding twenty dollars, twenty cents; over twenty dollars and not exceeding thirty dollars, thirty cents. A blank for the amount required is to be filled up by the applicant, who must, in all cases, give his own Christian name in full; and when the Christian name of the payee is known, it should be so stated; otherwise initials may be used. The Christian names of married women must be given, and not those of their husbands. For example, Mrs. "*Mary* Brown" must not be described as Mrs. "*William* Brown." Where the order is to be sent by or to a firm, the usual firm name is all that need be given. The order is then given to the party applying for it according to number, stating the amount, but not stating to whom it is payable or who deposited the money. A request is at the bottom of the order that the Postmaster shall pay the money to the person indicated in the letter of advice." The letter of advice is sent by the Postmaster with whom the money is deposited to the Postmaster who is to pay the order, and it contains the names of the depositor and of the person to whom the money is to be paid. The latter is to re-