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 num ber, 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 receive the order from the former, and most usually it will be sent in inclosure by mail. A party who has possession of an order will be required, before payment it made to him, to state the Christian and surname of the party who sends it and his address, and also his own. This regulation is designed to prevent an unauthorized person from obtaining the amount of an order, should it, by accident, fraud, or theft, fall into improper hands. The Post-office Department will use all fair means to prevent dishonesty, but if an order is once paid to the party presenting it, through misrepresentation, the Government will not be liable to any further claim. The public are therefore cautioned as follows:—

1st, To take all means to prevent the loss of a money order.

2d, Never to send the order in the same letter with the information required on payment thereof.

3d, To be careful, on taking out a money order, to state correctly the Christian name, as well as the surname of the person in whose favor it is to be drawn.

4th, To see that the name and address of the person taking out the money order are correctly made known to the person in whose favor it is to be drawn.

Neglect of these instructions will risk the loss of the money, besides leading to delay and trouble in obtaining payment.

Under no circumstances can payment of an order be demanded on the day of its issue.

If the money is not called for within ninety days after the date of the order, there will be difficulty in obtaining it. The regular form of the order must not be clipped or mutilated. When the payee of an order desires the same to be paid to any other person, he must fill up and sign a form of indorsement, and furnish such second party with the information required to obtain payment of his order, who, upon receiving payment, must sign his name upon the face of the order. More than one indorsement is prohibited by law, and will render the order invalid and not payable.

This system, entirely new to our country, is founded upon the English plan. In Great Britain it has been very useful, and is exceedingly popular. Properly managed, it will be in the United States an accommodation which will soon be discovered to be indispensable in the management of business between different sections of the country.—*Philadelphia Inquirer.*

A PRACTICAL ICE-MAKING MACHINE.

A paper was recently read before the British Association by Mr. A. C. Kirk, in which after explaining an ether machine for making ice, he said:—

"Such a machine was in use for fully a year, at the works of Messrs. Young & Co., Bathgate, for cooling the paraffin oil of which they are the well-known makers, in order to extract the solid paraffin it contains, a substance of great value in itself, and whose presence in the oil is otherwise desirable. This machine proving too small for the increasing size of the work, and the use of a material so volatile, inflammable, expensive, and in all respects so dangerous as ether, being a serious drawback, I was requested, in the beginning of 1862, to try if some efficient substitute could not be found. Atmospheric air being the substitute which at once suggested itself to me as not only safe but inexpensive, I commenced a series of experiments, which at last resulted in a small model, by which I was able to freeze mercury. A large machine was immediately proceeded with, which worked so satisfactorily that the use of the ether machine was discontinued, and this year at the works a more powerful one has been erected, capable, if applied to such a purpose, of making three tuns of ice in twenty-four hours. I shall now proceed to describe the nature of this machine, which, it will be seen, is allied to the air-engine in the same manner as the ether machine is to the steam-engine. If we enclose a quantity of air in a strong vessel, into the top of which we fix a common air-syringe, and force the piston downwards by hand, we shall compress the enclosed air, which, by the power so spent, will be heated; and if we now cool the whole apparatus down to its original temperature, and allow the air to force the piston gradually back, the air by the effort will be cooled; but, inasmuch as the cooled air will not occupy the same space as the air originally did, the piston will not return to the point at which it was when we commenced, and thus less power will be given out during the expansion of the air than was spent in its compression. It is not necessary that the air be at the atmospheric pressure: if air of greater density be employed, the cooling power of the machine will be increased. We have thus got an elementary cooling machine, and as before power is spent in working it. To render this a practicable machine, the first thing necessary is to perform the compressing or heating operation, and the expansion or cooling operation in separate compartments; the one surrounded by water to abstract the heat generated, and the other surrounded by the substance to be cooled, or from which heat is to be taken. The one compartment being thus very cold and the other comparatively warm, the next thing is to provide means by which the air can be continually transferred from one to the other, without carrying heat from the hot compartment to the cold. Thus, if the temperature of the hot compartment be 70°, and that of the cold zero, the air must enter the cold compartment preparatory to expansion at a temperature as nearly zero as possible, and in returning to the hot compartment must enter it preparatory to compression, at a temperature as nearly 70 degrees as possible. That beautiful invention of Stirling, the regenerator, or respirator, as it is sometimes called, composed ordinarily of a large quantity of wire gauze, through which the air passes, enables us to accomplish this very perfectly. When the machine is fairly a-going, the layers of gauze next the cool compartment become as cold as the compartment itself, and those next the hot compartment as hot, while the layers between those shade off through the intermediate grades of temperature. Thus the air, in passing from the hot to the cold compartment, warms the gauze and is itself cooled, and the cold air in returning is gradually warmed, cooling the gauze in its course; and although the air is continually being passed backwards and forwards from the hot compartment to the cold, and *vice versa*, no heat is conveyed by it from the hot end to warm the cold and interfere with the cooling power of the air during expansion. By the help of the diagrams, Mr. Kirk then explained the arrangements by which this was carried out. He concluded by saying that the advantages attending the use of his machine were, that no expensive or dangerous fluid was employed, involving risk of fire of suffocation to the attendants; that the cooling power might be reduced to any extent when required, the consumption of motive power being similarly reduced; and that cupped leather packings might be employed, which gave so little trouble, that in the first machine one worked for four months without being touched. Mr. Kirk then, at the request of the meeting, gave some explanations of parts of his machine which had not been understood, and those explanations appeared to fully satisfy the meeting of the practical utility of the machine. He further stated that the cost of the machine, without boilers, was £700.

Professor Miller said he was glad to hear that the machine had been practically successful. The inventor had employed a new principle in a new, simple, and effective manner.

Mr. Young said he was able to say that the machine was all that was ever expected. Former machines they had used always kept them in a state of bodily terror, and once they had a slight fire; but by using this new machine there was no longer any cause for fear. The machine was an extraordinary success. It went on day and night, without intermission and without trouble. With one tun of coal, costing 4s., they could produce one tun of ice. He was glad to be able to give his testimony to the perfect working of the machine (applause). All manufacturers must hail such a chemical invention.

Professor Miller—Has it the effect of the ether machine?

Mr. Young—It has just the same effect as the old ether machine, without the loss of ether (applause).

New Way to Send a "Cipher" Message.—Wrap a strip of paper slanting around a pencil case, ruler, or any round object, making all the edges meet. Write upon it, and then unwrap it; it will be quite a chaos, but when brought back to its old position on the roller, it will be as legible as this print. The roller would have to be the same in both cases, with the sender and recipient, but this could easily be arranged beforehand. The message might also be written zig-zag on the roller, and thus increase the difficulty of reading it.

FOREIGN INTELLIGENCE.

Sugar and Corpulence.—Alderman Mechi writes, "I can confirm personally Mr. Banting's statement that sugar produces corpulency. Some time before that gentleman published his case, I found myself getting too 'aldermanic,' in spite of severe exercise. Hearing casually that a very stout lady had diminished to genteel proportions by leaving off sugar in her tea and coffee, I followed her example, and found that I had lost fourteen pounds weight in six weeks—very much to my comfort. The quantity of sugar I usually consumed was under one ounce and a half daily. As I much prefer my tea and coffee sweetened, I again ventured moderately, and soon gained seven pounds; so now I regulate my weight principally by the use or discontinuance of sugar. The ready solubility of this saccharine matter permits it to be absorbed immediately by the system. I hope that my agricultural friends who wish to farm profitably by the rapid fattening of their cattle and other live stock will take the hint. The scarcity of roots this season will render the use of treacle, sugar pods, linseed and other saccharine and oleaginous substances absolutely necessary, mixed with straw, chaff or bulky substances."

Cast Steel in Boilers.—The employment of cast steel is every day extending, and often with advantage. In 1859 Herr Kohn, a German engineer, placed in a boiler 40 feet in length, made of plates 11 millimetres thick, a sheet of steel only 5½ millimetres thick. This sheet, which was placed near the furnace, was found, after two years and a half of very sustained work, in a perfect state of preservation, while the neighboring sheets of iron plates had suffered greatly. The steel plate bore, besides, no incrustation, a result which was attributed to the more rapid action of the water on coming in contact with it. Experiments made in this direction have not, however, always proved successful. Thus the Austrian railway company had six locomotives made with boilers of cast steel. The working of these engines was not satisfactory, the fire boxes displaying alarming rents after a short time. The Austrian railway company is, however, determined to persevere with further experiments.

Hay and Honey.—It is a common saying that a year in which hay is abundant proves a good one for honey. The present one cannot be called a good year for either hay or grass, but few will deny its goodness for producing honey. The warm weather about the middle of May caused many bees to swarm at that early day, and we have heard of several of those swarms producing 40 lbs. of honey. Those which swarmed at a later period also did well, gaining as much as two pounds a day during the fine days of July. This season has been the best one for honey since the year 1859.

Another new English Steam Engine.—A new steam engine has been invented by Messrs. Martin & Hodgson, of Manchester, England, which has two pistons in each cylinder on a vibrating shaft, just as a door swings on its hinges. Motion is communicated from the cylinder shaft to the screw shaft by means of levers and connecting rods. This engine, or its principle, was designed by Captain Ericsson many years ago. The *Princeton* frigate had two, and drawings of them can be found in "Stuart's Naval and Mail Steamers of the United States."

There are five evening papers issued in London, but before the month has passed another will be added to the number. The *Glow Worm* will be published some hours later than the usual time for issuing the *Evening Standard*. It will contain the latest news from the city, the Houses of Parliament, and the race-course. It will be sold for one penny.

Greased Steam.—An advertiser in a foreign mechanical journal makes use of the following language in puffing a new oil cup:—

"The above Lubricators grease every particle of steam previous to its passing through the valves into the cylinders."

We have heard of greased lightning, but greased steam is a decided novelty.

Patent-leather belts are used in England for out-door work. They are said to be impervious to damp and retain their length in all weather.