patronize either the meat cart or the market for a supply of meat through the year. It is more convenient as well as more economical to lay in a store for family use that has been fattened at home, and then you are sure you have a good article, that is safe to use.—*Farmer's Wife in Country Gentleman.*

THE NUTRITION OF ROOTS.

The microscope does not show openings in the cellular tissues of a root through which even the most minute particle of solid matter could pass, and there is no mechanical power that could pulverize any solid so fine that it could pass through those extremely small canals which enable the root to absorb nourishment in a liquid or gaseous form.

For a long time the absorbing power was supposed to be localized in a special organ at the end of the root. But this has been disproved, as the vegetable cone situated there is covered with a skin that possesses little or no power of absorption.

The maximum of absorption takes place directly above this cone, in a part of the root covered with peculiar fibers. In ascending the root these fibers gradually diminish and disappear, and higher still the skin itself exfoliated, and is replaced by a new tegument that grows less and less permeable with age. Both the anatomy of the plant and experiment prove that the absorbing power diminishes from the point to the base of the root.

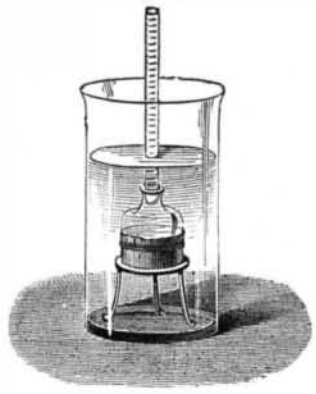
The subterraneous nutritive fluid of the soil is always very poor in plant building substances, of which it only contains from a few thousandths to one hundredth of its own weight. The plant soon exhausts the small amount of soluble matter contained in arable land, but this matter is daily renewed by the chemical action of sunlight, and the various natural agents cause a sort of digestion to take place in the soil, converting insoluble into soluble bodies. The fertility of the soil is not shown by the amount of nutritive matter that it can dissolve at a given moment in water, but by the amount of matter it contains that with time will become soluble. We should, therefore, remember in applying liquid fertilizers that they should be largely diluted if we would imitate the natural conditions of vegetation.

All roots possess an elective power of absorption, as they will only absorb those substances that are suitable to nourish them, and reject all others. Each plant, so to speak, follows a diet appropriate to its own organization and character, and generally when the soil does not contain the necessary elements the plant, instead of adapting its chemical condition to that of the soil, will suffer and prematurely die.

We do not yet fully understand the mechanism of this elective absorption, but we are sure that the force of endosmose enters largely into the phenomenon. This force is shown in the following experiment:

Take a glass bottle (see Fig. 1) from which the bottom has been removed and replaced by some vegetable or animal membrane, fill it with some uncrystallizable solution, such as gum arabic, and close it with a cork, in which is inserted a glass tube open at both ends. If this apparatus is placed in pure water the solution gradually mounts in the tube, proving that the water has penetrated through the membrane and augmented the volume of liquid in the bottle. This property of membranous tissues, by which liquids of unequal densities are enabled to percolate through it and intermix, is called the force of endosmose, and was first observed by Durochet. The instrument that exhibits and measures the force is the endosmometer. The cells of the root act toward the soil and in regard to each other as minute endosmometers; and formerly it was assumed that the force of endosmase was the only power that introduced the water from the soil into the root, and caused its circulation through the plant. But this explanation is insufficient, because during the summer, when the circulation of the sap is the most rapid, the cells of the plant contain gas, and consequently are not perfect endosmometers.

Fig. 1.



But if the causes of absorption by the roots are obscure, its effect is well known, for we have observed that the power which forces the sap upward into the tree is very great, and can easily be measured by a "mercurial manometer."

This is a glass tube, in the form of a *v* (see Fig. 2), with unequal ends, both of which are open. The shorter end is enlarged in the middle so as to form a small reservoir, and is bent at right angles. If mercury is poured into the tube, until it half fills the reservoir, the mercury will remain at the same level on both sides.

If we wish to know the force of the sap as it rises from the root into the trunk, we cut the latter close to the ground and inclose the end of the stump in a glass cylinder, in one side of which is inserted the small end of the manometer. Fill the cylinder with water and lock it. When the instrument is thus arranged, the varying pressure of the sap is indicated by the rise of the mercury, and it is easy to calculate the exact force.

The pressure of the sap at different heights can be known by simply inserting the manometer in the side of the tree, as shown in Fig. 4.

Numerous observations have proved to us that the propulsive force of the roots, like all vital forces, is subject to variations produced either by external or internal causes.

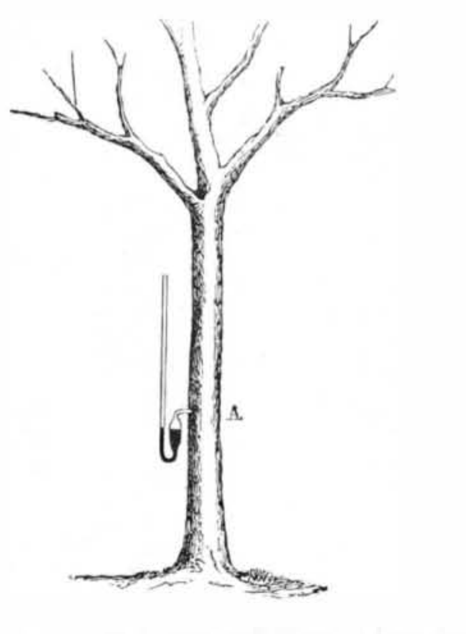
Fig. 2.

Fig. 3.

The strongest pressure observed by Hules (April, 1725) was equivalent to three-tenths of an atmospheric pressure. Since then still stronger pressures have been observed, in some instances to the pressure of one and a half atmospheres.

The propulsive force of the sap occasionally produces a curious phenomenon called the oozing sap. A little drop resembling pure water collects on the end of the leaf, and

Fig. 4.



gradually enlarges till it falls, and is replaced by another. This takes place intermittently, and generally during the night or after a copious rainfall.

This phenomenon of the oozing sap can be artificially produced by forcibly injecting water into the bark of the tree.

Fig. 5.

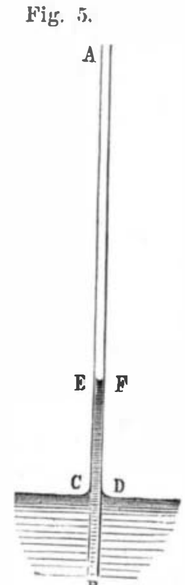
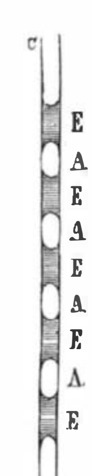


Fig. 6.



Soon after, drops of water will be seen issuing from the surface of the bark.

Sometimes this propulsive force suddenly disappears, and gives place to the opposite force of absorption, as may be seen in the following experiment. If, at the close of a warm summer day, when its transferation has been abundant, the plant is cut down to the ground, and a glass cylinder full of water fastened on the stump, the water will be seen to gradually diminish and disappear. The root will absorb it through the cut surface, just as a branch will absorb through its lower section when it is placed in water. In each case the cause is the same, the insufficiency of water in the tissues of the root or branch

The varying operation of these two forces can be seen by a manometer inserted in the tree. In the morning the mercury descends in the longer side of the instrument, thus showing the absorbing force of the tree, and later, again changes its level and registers the opposite force, which increases during the day, especially if the rays of the sun fall on that side of the tree where the manometer is inserted.

Capillary attraction is another motive force in the circulation and movement of the sap. The most familiar illustration of this force is to take a very small glass tube and plunge one end of it in water. The liquid will immediately rise in the tube above the level of the surrounding water, to a height proportionate to the diameter of the tube, and the smaller the diameter the higher the liquid will mount.

It is generally admitted that capillary attraction is one of the principal causes of the ascension of the sap. Still it is necessary to recollect that during the period of the most rapid movement of the sap, the veins and fibers do not contain unbroken columns of water, but are filled alternately with drops of water and bubbles of air, and later in the season only with air, as shown in Fig. 6.

The capillary phenomena in the plant are of a complex nature, and vary according to the time of the year, and heat, especially solar, dilates the interior gases of the plant, and by increasing their elastic force exercises a great influence on these phenomena, for the sap always percolates more abundantly through the insertions made in the tree when the sun falls warmly upon it.

IMPROVED GAS BURNER.

The accompanying engraving represents a new form of gas burner invented by Dr. McGeorge. It is claimed that it is very economical in burning gas, and secures complete combustion. It is well known that ordinary burners, because of imperfect combustion, throw off a great deal of poisonous carbonic oxide and carbonic acid gas, which vitiates the atmosphere very rapidly. The burner shown in the annexed engraving secures a more perfect combustion of gas, and thus diminishes the formation of poisonous gases, and at the same time, as shown by careful tests, an increase of fifty per cent in illuminating power secured by perfecting combustion alone, the quantity of gas consumed remaining the same.

In this gas burner, which has been named the "focus gas burner," two small side jets are directed to a point at the base of the flame, throwing heated gas mixed with air. By this means the gas is greatly rarefied and expanded, and an additional amount of oxygen is conveyed to the flame. The particles of carbon or blue portion of flame (the gas being superheated) are reduced so as to eliminate the greatest amount of light. This more perfect combustion also checks the outflow of carbonic acid gas.

Gas, like steam, admits of expansion by heat to almost any limit. The more the particles are heated and separated, the more perfect combustion is secured, and a larger proportion of light is produced.

If a regulator is used, a sufficient pressure is given through it to carry the burner to complete combustion. This pressure is offset in the "focus burner" by a novel check, which is very simple and effective. No complicated valves nor inside apparatus, which are liable to become smutty and fill up, are used.

The inventor gives the following photometric test, made in May last, at one inch pressure: A common burner, placed upon the test, gave an hourly consumption of 2 feet; light emitted equal to 6 star candles. The "focus burner," with the same amount of gas; light emitted equal to 11¾ candles.

Further information may be obtained from J. C. O. Redington, General Manager, 27 Park Place, New York.

Telegraphy Between Australia and London.

On the 1st of October last, a message of sixty-nine words was forwarded by the Governor of Victoria announcing the opening of the Melbourne Exhibition on that day. The message was dispatched from Melbourne at 1 P.M., and reached London at 3:43 A.M., on the same day, or 9 hours 17 minutes before the hour of its despatch. Allowing, however, for the difference of time between the two cities, it occupied only twenty-three minutes in transit. The route of the message was over the lines of the Victorian and South Australian colonies, the cables of the Eastern Extension, Australasia, and China Telegraph Company, the lines of the Indian Government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French Governments, and the rapidity of its transmission shows the harmony with which these various administrations work together. The total distance traversed was 13,398 miles.