

we find that in all plants, in all their organs, a certain quantity more or less of both of these classes of compounds dissolved in the sap, or deposited in the seeds and bulbs.

Now this leads to the important fact, as before stated, that animals have not the power of creating any of these organic substances, and that the whole animal world lives upon the vegetable kingdom exclusively; it is in the vegetable kingdom, therefore, that the great laboratory of organic life is found; it is there that both vegetable and animal substances are compounded.

Now comes the question, what do plants live upon? The reply to this and its correct solution is the most important that can engage the agricultural chemist, and, indeed, of every human being; and, in order to understand the changes which inorganic matter undergoes in its conversion into the materials fit for the food of man and animals, it will be necessary to know something of the structure and functions of plants, which are the only machines by which these wonderful results are produced.

A perfect plant is made up of a number of different parts or organs. The root, the stem, and leaves, which form the organs of nutrition and growth.

The flowers and seeds which form the organs of reproduction. The roots are for fixing the plant in the soil, and also for absorbing fluids containing various soluble substances.

The stems are for conveying liquids to the leaves, for giving stability and firmness, so as to elevate the leaves to the air, and expose them to light.

The leaves are the organs by which the crude sap, absorbed by the roots, and transmitted by the stem, is converted by the air and light into nutritious sap, from which all vegetable substances are formed.

The flowers, the fruit, and the seed, are the organs of reproduction, and contain the germs of future plants.

All these parts constitute what we call an entire plant, and all formed or made up of a mass of cells, or little closed sacks joined together in all directions, putting on various shapes and forms, which variation of shape depends, frequently, but not altogether, upon the pressure they may be subject to, and also the direction and force of the circulating juices. Before we proceed further, it will be necessary to understand the structure and functions of these cells, especially when we consider that all plants as well animals, formed on the earth's surface, are not only made up of a mass of them, but that they make their first appearance under the form of a cell, and that in the lowest forms of vegetables and animals, this cell forms the whole plant or animal. A review of the life of the cell then must necessarily precede the endeavour to comprehend the whole plant. When the cell forms the whole plant, as it does in moulds, mildews, and blights of corn, as red rust, smut, and bunt, or when the cell forms the whole animal, as it does in some infusoria, it is an independent being, it lives for itself alone, it imbibes fluid nourishment from without, out of which it forms new substances, part of which goes to its growth, another part is laid up in store for future requirements, and another portion is expelled as useless, to make room for the entrance of new matter; in a short time the cell comes to maturity; it then divides, or a number of small grains are formed in the inside of the cell. These are the germs of new plants, and when liberated by the rupture of the parent cell, go through precisely the same series of changes.

But it will naturally be asked how the cell, which is a closed sack, obtains fluid from without; this is effected by a physical law, called endosmosis. If two fluids of different densities, as water and brine, be separated only by animal or vegetable membranes, the light fluid, the water, will pass through into the brine, or denser fluid, and in a small degree also the denser fluid will pass into

the thinner, in this case it is called exosmosis, so that in whatever part of a plant the fluids are the most dense, there will be the greatest circulation and the greatest activity.

This is the only cause of circulation in all parts of plants consisting of cells, but in those plants possessing ducts or tubes, which, as we shall presently see, are only cells elongated; another physical agency comes into play, which is the force of capillary attraction; it is known that in delicate tubes which have their extremities, immersed in a fluid; the level of the fluid within the tubes becomes raised above that of the fluid without, and this, in proportion to the smallness of the tubes; so that, in this capillary attraction of the tubes of plants, and the absorption by the cells called endosmosis, we have sufficient cause to produce the rise of the sap, and the existence of these two causes is capable of direct experimental proof.

The effect of this law of endosmosis possessed by membranes is beautifully seen in our own bodies. Spring water, containing no salts, and therefore of much less density than the blood, if swallowed into the stomach is taken up into the blood vessels with great rapidity. Now if this water should contain the same quantity of salts as the blood, it would remain untouched by the blood vessels and produce a feeling of weight. But if we drink a solution containing more salt than the blood, and therefore of greater density, the fluids of the blood will pass through into the solution, and purgation will be the consequence, as in the case of taking Epsom salts, or common salt.

This power of absorption by endosmosis is destroyed by certain substances as opium and tannin.

PHYSICAL GEOGRAPHY.

Of all modern sciences, the science of the globe has made the most rapid, the most remarkable, and the most important progress. Bacon makes the fine remark, that while the works of man advance by successive additions, the works of Nature all go on at once; thus the machinist adds wheel to wheel, and spring to spring, but the earth produces the tree, branch and bark, trunk and leaf, together. There is something analogous to this combined operation in physical geography: a whole crowd of remarkable discoveries seem to have burst on us at once, expressly designed to invigorate and impel our progress in geographical science. Thus, our century has witnessed new phenomena of magnetism, new laws of heat and refrigeration, new laws even of the tempest, new rules of the tides, new expedients for the preservation of health at sea, new arrangements for the supply of fresh food, and even for the supply of fresh water by distillation, and all tending to the same object—the knowledge of the globe.

The use of steam, to which modern mechanism has given almost a new existence, and certainly a new power—the conquest of wind and wave by the steam-ship, and the almost miraculous saving of time and space by the steam-carriage; the new necessity of remote enterprise, originating in the urgency of commercial and manufacturing difficulties; the opening of the thousand islands of the Indian Archipelago, till now known to us as scarcely more than the seat of savage life, or the scene of Oriental fable; the breaking down of that old and colossal barrier of restrictions and prejudices, which, more than the wall of China, excluded England from intercourse with a population amounting to a third of mankind; and most of all, those vast visitations of apparent evil, which the great Disposer of things is evidently transmuting, year by year, into real good, by propelling the impoverished multitudes of Europe into the wildernesses of the world—all exhibiting a stupendous combination of simple means, and a not less astonishing convergency to the one high purpose, the mastery of the globe—place Physical