Sect. IL—*Of the Vegetation of Plants.*

Art. L—*Of Soils, and of the Food of Plants.*

The plant, like the seed from which it sprang, is con­structed of two elementary systems, denominated vessels and cells. For a detailed account of these, and of the opi­nions held concerning them, we must refer to our former article. By these systems, variously blended and combined, the several textures, denominated Cuticle, Bark, Wood, and Pith, are composed. The structure of these textures, as they occur in different varieties of herbs and trees, has likewise been described in that article.

Though the vessels of plants differ in form and structure, yet, with regard to use, they appear to be but of two kinds; those, namely, which receive and convey the common sap or lymph, and are named, therefore, Sap or Lymphatic Vessels; and those which contain and convey the juices proper to each species of plant, and are therefore denomi­nated Proper Vessels. In trees, the sap-vessels are found chiefly in the wood, and the proper vessels in the bark; but in many herbs and in palms, both kinds of vessels are associated together through the entire stem. Whether they occupy distinct places in the vegetable, or are associated to­gether, their functions are respectively the same ; the sap­vessels being always employed in raising the sap upward, and the proper vessels in conducting its descent.

In all parts of plants, the vessels are in contact with cells, which serve sometimes the purpose of a connecting medium ; sometimes to fill up vacuities or augment the bulk of parts; and sometimes as receptacles for various secretions. Be­tween the vessels and cells a vascular communication exists, so that matter deposited at one time in the cells of the plant, may, at another, be taken up and again mixed with the fluids, as occurs in the germinating seed; and these functions of in­ternal secretion and absorption seem to be performed, in plants, as well as in seeds, by the alternate exercise of the same vessels, acting at different times and under different cir­cumstances.

Although, as we have seen, plants not only grow, but produce flowers and fruits without the aid of soil, yet, in ordinary circumstances, they draw the materials of their food from the earth. In an inquiry, therefore, into the nutrition and growth of plants, we have to consider the nature and pro­perties of soils, which afford them habitation and nutriment— the absorption of this nutriment and its conveyance through the vessels—the changes of quality which it experiences in its course, so as to fit it for nutrition—the agents requir­ed to effect these changes, and the mode in which they act —and, lastly, the manner in which this nutrient matter, af­ter having undergone its destined changes, is applied to nourish and augment the plant.

The soils in which plants grow are composed of organiz­ed and inorganic matters in various proportions. Of inor­ganic substances, the earths which prevail most are silica, alumina, and lime. With these earths, magnesia and cer­tain metallic oxides, particularly that of iron, are often to be found. To these we may add alkaline matter, and animal and vegetable substances in different stages of decomposi­tion anti mixture. According to the proportions in which these mineral and organized remains are present and blend­ed together, the soil will vary greatly in texture, in its pro­perty of retaining heat and moisture, and in its degree of fertility. To say, however, what mixture of substances con­stitutes the most perfect soil would be very difficult: for not only does climate greatly modify the natural condition of soils, but plants themselves exhibit the greatest diversity of choice or liking in this respect. Hence it is, that the soil and climate best suited to one plant, are ill adapted or un­suited to another; and that every part of the earth’s surface, in which heat and moisture sufficient to sustain vegetation are present, is more or less clothed with its appropriate spe­cies of plants.

In considering physiologically the *uses* which the different ingredients of soils serve in vegetation, we must bear in mind that certain chemical elements seem essential to the constitution of vegetable matter; while others, though pre­sent and highly useful, are not so indispensably necessary. Thus, the vegetable substances, gum, starch, and sugar, are composed essentially of oxygen, hydrogen, and carbon; and woody fibre, when freed from all adventitious matter, is found to be composed of the same elements, united nearly in the same proportions. Now, considering woody fibre as the basis of the vegetable organs, and as formed, in germi­nation, directly from the *fecula* of the seed, and probably the water in which it is dissolved, we may presume, that the elements which thus compose fecula, water and woody fibre, are the true constituents of vegetable matter.

In certain kinds of vegetable matter, which approxi­mate to animal substance, nitrogen is a necessary ingre­dient. In other kinds, the vegetable substance partakes largely of the earthy materials of the soil. Hence lime and silica are abundant in certain plants; but as such sub­stances can enter plants only in a state of solution, the earths met with in vegetables may not, says De Saussure, depend so much on those which constitute the basis of the soil, as on those held in solution by the water which it contains. Some have even supposed that the earths may be formed or generated in plants by the vegetative process ; but the facts alleged in support of this opinion are not sufficiently precise. While, therefore. It is admitted, that earths are carried into plants, and, in certain tribes, enter largely into the composition of some of their textures, we have no evidence that they contribute directly to nutrition, or form an essen­tial element in the composition of vegetable matter. Their use in affording station or habitation to vegetables is suffi­ciently obvious; and the temperature and moisture of the soil will also depend much on their kinds, proportions, and intermixture.

Together with the earths, chemical analysis shows, that sulphur, phosphorus, some metallic oxides, and particularly alkaline matter, exist in plants. Certain saline substances seem indeed necessary to vegetation. Marine plants lan­guish in a soil destitute of common salt; and it is well known, that potash forms a large portion of the incombustible mat­ter of land vegetables, and is especially abundant in the leaves. De Saussure found phosphate of lime in every plant he analysed. Certain plants throve well only in soils con­taining nitrates of lime or potash ; and sulphate of lime or gypsum accelerated much the growth of lucerne and trefoil. These saline ingredients are highly useful, and the alkalis, in particular, seem necessary to the due perfection of the vegetative process; but, as the elements of these substances do not form a necessary constituent of the vegetable fibre, they cannot be considered as an essential part of the food of plants. Perhaps they may be regarded as condiments which aid in the process of assimilation ; and, as will ap­pear, they are otherwise highly useful in the vegetable economy.

With regard to the organized remains, which form so large a portion of the most fertile soils, they are not only soluble in water, like the other ingredients, but are com­posed of the same elements as vegetable substance. M. de Saussure found pure vegetable mould to yield, by dis­tillation, products similar to those of the undecayed wood from which it had been formed, differing chiefly from it by containing a larger proportion of charcoal and some azote. Water dissolved a portion of this mould; and when deprived of this soluble portion, the residue, though unaltered in ap­pearance, did not support the growth of plants so well as before. The part thus dissolved by water exhibited the properties of *extractive,—*a principle found in the sap, and