

enable it to obtain the necessary supplies from the upper layers of the soil; and the root will become roundish instead of long.

Plants exhaust only that portion of the soil which comes in contact with their roots; and a spindle root may be able to draw an abundance of nourishment from land, the surface of which has been exhausted by short or creeping roots.

The roots of plants of the same and of analogous species, always take a like direction, if situated in a soil which allows them a free development; and thus they pass through, and are supported by, the same layers of earth. For this reason, we seldom find trees prosper that take the place of others of the same species; unless a suitable period has been allowed for producing the decomposition of the roots of the first, and thus supplying the earth with fresh manure.

To prove that different kinds of plants do not exhaust the soil in the same manner, it is perhaps sufficient for me to state, that the nutrition of vegetables is not a process altogether mechanical; that plants do not absorb indiscriminately, nor in the same proportions, all the juices and salts that are presented to them; but that either vitality, or the conformation of their organs, exerts an influence over the nutritive action; that there is on the part of plants some taste, some choice regarding their food, as has been sufficiently proved by the experiments of Messrs. Davy and de Saussure. It is with plants as it is with animals, there are some elements common to all, and some peculiar to each kind: this is placed beyond doubt, by the preference given by some plants to certain salts, over others.

PRINCIPLE 4. *All plants do not restore to the soil either the same quantity or the same quality of manure.*

All plants that grow upon a soil, exhaust more or less of its nutritive juices, but all return to it some remains, to repair a part of its loss. The grains and the oleaginous seeds may be placed at the head of those which exhaust a soil the most, and repair the least the injury done it. In those countries where plants are plucked up, they return nothing to the soil that has nourished them. There are some plants, to be sure, besides those mentioned above, that by forming their seed, consume a great part of the manure contained in the soil; but the roots of many of these soften and divide the soil to a considerable depth; and the leaves which fall from the stalk during the progress of vegetation restore to the earth more than is returned by those before mentioned. There are others still, the roots and stalks of which remaining strong and succulent after the production of their fruits, restore to the soil a portion of the juices they had received from it; of this kind are the leguminous plants.

Many plants that are not allowed to produce seed exhaust the soil but very little; these are very valuable in forming a system of successive crops, as by introducing them into the rotation, ground may be made to yield for many years without the application of fresh manure; the varieties of trefoil, especially clover and sainfoin, are of this sort.

PRINCIPLE 5. *All plants do not foul the soil equally.*

It is said that a plant fouls the soil, when it facilitates or permits the growth of weeds, which exhaust the earth, weary the plant, appropriate to themselves a part of its nourishment, and hasten its decay. All plants not provided with an extensive system of large and vigorous leaves, calculated to cover the ground, foul the soil.

The grains, from their slender stalks rising into the air, and their long, narrow leaves, easily admit into their intervals those weeds that grow upon the surface,

which, being defended from heat and winds, grow by favour of the grain they injure.

Herbaceous plants, on the contrary, which cover the surface of the soil with their leaves, and raise their stalks to only a moderate height, stifle all that endeavours to grow at their roots, and the earth remains clean. It must be observed, however, that this last is not the case unless the soil be adapted to the plants, and contain a sufficient quantity of manure to support them in a state of healthy and vigorous vegetation: it is for want of these favourable circumstances that we often see these same plants languishing, and allowing the growth of less delicate herbs, which cause them to perish before their time. Vegetables sown and cultivated in furrows, as are the various roots and the greater part of the leguminous plants, allow room for a large number of weeds; but the soil can be easily kept free by a frequent use of the hoe or weeding fork; and by this means may be preserved rich enough for raising a second crop, especially if the first be not allowed to go to seed.

The seeds that are committed to the ground often contain those of weeds amongst them, and too much care cannot be taken to avoid this: it is more frequently the case, however, that these are brought by the winds, deposited by water, or sown with the manure of the farm-yard.

The carelessness of those agriculturists who allow thistles and other hurtful plants to remain in their fields, cannot be too much censured; each year these plants produce new seeds, thus exhausting the land, increasing their own numbers, till it becomes almost impossible to free the soil from them. This negligence is carried by some to such an extent, that they will reap the grain all around the thistles, and leave them standing at liberty to complete their growth and fructification. How much better it would be to cut those hurtful plants before they flower, and to add them to the manure of the farm. From the principles which I have just established, we may draw the following conclusions:—

1st. That however well prepared a soil may be, it cannot nourish a long succession of crops without becoming exhausted.

2d. Each harvest impoverishes the soil to a certain extent, depending upon the degree of nourishment which it restores to the earth.

3d. The cultivation of spindle roots ought to succeed that of running and superficial roots.

4th. It is necessary to avoid returning too soon to the cultivation of the same or of analogous kinds of vegetables, in the same soil.*

5th. It is very unwise to allow two kinds of plants, which admit of the ready growth of weeds among them, to be raised in succession.

6th. Those plants that derive their principal support from the soil, should not be sown, excepting when the soil is sufficiently provided with manure.

7th. When the soil exhibits symptoms of exhaustion

* In addition to the reasons I have given why plants of the same or analogous kinds should not be cultivated in succession upon the same soil, there is another which I will here assign. M. Olivier, member of the French Institute, has described with much care all the insects which devour the neck of the roots of grain; these multiply infinitely, if the same or analogous kinds of plants be presented to the soil for several successive years; but perish for want of food, whenever plants not suited to be food for their larvae, are made to succeed the grains. These insects belong to the family of Tipule, or to that of flies.—(Sixteenth Vol. of the *Memoirs of the Royal and General Agricultural Society of Paris.*)