

time the soil in which a certain kind of plant grows becomes so loaded with this rejected matter that the same plant refuses any longer to flourish in it. And thirdly, that though injurious to the plant from which it has been derived, this rejected matter may be wholesome food to a different order of plants, and hence the advantage to be derived from a rotation of crops. Nietner, another of the observers of this excreting power of the roots of plants, says that the prolific rye crop obtained without manure from the land which had been three successive years in clover, was owing to a large quantity of this excreted matter contained in the soil, and which he considered to be highly nutritive to the rye. He also states that turnips or beets raised on the same ground which had previously grown tobacco, were possessed of a remarkably bitter and unpleasant taste and scarcely eatable; this he says was owing to the excretions of the tobacco plant, which were absorbed and assimilated by the turnip and beet. Meyen also ascribes the effect of the clover on the rye crop, to the green manure supplied by its roots and stubble, and that of tobacco to the undecomposed organic substances contained in the sap and substance of the stem and roots, of which so large a quantity is left behind in the field. If the opinions of these authors are correct it is certainly a strong argument in favour of a rotation of crops.

Some writers, however, on this subject, do not quite coincide in the opinions of those first quoted, or at least, do not go so far as to agree with their excretory theory in the detail; yet all admit, so far as I am aware, that such a thing really does take place in all plants at some period of their growth, but they do not think that the vegetable excrement is exuded in such abundance as to prove so injurious to the species as has been stated by those already referred to. But even admitting the opinions of these last, of whom Johnson and Macaire may be mentioned as among the number, that plants do not secrete excrementitious matter in such abundance as stated by the others, yet if they secrete any, and if it be hurtful even in a small degree, the validity of the argument still remains in favor of a rotation of crops. We might reason from analogies like the following which tend to give weight to some of the opinions given above. Animals abhor the verdure, however luxuriant, that is caused by a decomposition of their own excrement, while a different species of animal will eat the same with avidity, and no doubt consider it a dainty morsel. This almost every person of observation must have noticed. Again it is said by some that our forests are, in like manner, subject to a change of wood, and that if cleared of the kind of timber now growing in one part, as for instance pine, and allowed to remain uncultivated, it would in time be replaced by trees of a different kind. If this be the case, it is certainly, a very striking proof from nature, of the necessity of a rotation of crops.

Sir Humphrey Davy was the first to introduce a theoretical rotation of crops into England.—The following is his *rationale of rotation*:
 "It is a great advantage in the convertible system

of cultivation, that the whole of the manure employed; and that those parts of it which are not fitted for one crop, remain as nourishment for another. Thus if the turnip is the first in the order of succession, this crop manured with recent dung, immediately finds sufficient soluble matter for its nourishment, and the heat produced in fermentation assists the germination of the seed and the growth of the plant. If after turnips, barley with grass-seeds be sown, then the land having been little exhausted by the turnip crop, affords the soluble parts of the decomposing manure to the grain. The grasses and clover remain, which derive a small part only of their organized matter from the soil, and probably consume the gypsum in the manure which would be useless to other crops; these plants likewise by their large systems of leaves, absorb a considerable quantity of nourishment from the atmosphere; and when ploughed in at the end of two years the decay of their roots and leaves affords manure for the wheat crop; and at this period of the course, the woody fibre of the farm-

yard manure, which contains the phosphate of lime, and the other difficult soluble parts, is broken down; and as soon as the most exhausting crop is taken, recent manure is again applied. Peas and beans, in all instances, seem well adapted to prepare ground for wheat; and in some rich lands they are raised in alternate crops for years together. Peas and beans contain a small quantity of a matter analogous to albumen, but it seems that the azote, which forms a constituent part of this matter, is derived from the atmosphere. The dry bean leaf, when burnt, yields a smell approaching to that of decomposing animal matter; and in its decay in the soil, may furnish principles capable of becoming a part of the gluten of wheat. Though the general composition of plants is very analogous, yet the specific difference, in the products of many of them, prove that they must derive different materials from the soil; and though the vegetables having the smallest system of leaves will proportionably most exhaust the soil of common nutritive matter, yet particular vegetables, when their produce is carried off, will require peculiar principles to be supplied to the land on which they grow. Strawberries and potatoes at first produce luxuriantly in virgin mould, recently turned up from pasture; but in a few years they degenerate, and require a fresh soil. Lands in a course of years often cease to afford good cultivated grasses; they become (as it is properly said) tired of them; and one of the probable reasons for this is, the exhaustion of the gypsum contained in the soil." The principles of rotations of crops are thus laid down by Voart & Ch. Pictet: The first principle or fundamental point is, that every plant exhausts the soil. The second, that all plants do not exhaust the soil equally. The third, that plants of different kinds do not exhaust the soil in the same manner.—The fourth, that all plants do not restore to the soil the same quantity nor quality of manure.—The fifth, that all plants are not equally favorable to the growth of weeds.

The following consequences may naturally be