clover is called, are lightly fed off by sheep in the fall, and allowed to grow up in the spring to be cut for hay. The hay crop yields from two to three tons of hay per acre, (usually two and one-fourth to two and one-half); the second growth is either again mowed for hay, or fed off with sheep, according to the necessities of the farm; and finally, the clover sod is turned under the same fall, the ploughing being about two inches deep, and sown with wheat, the ground being thoroughly pressed before sowing, and the wheat well limed, or otherwise dressed with blue vitriol, &c., and drilled in. The result is, as might be expected, a crop of wheat of at least forty, often sixty bushels per acre The same course is again followed with the same results, the land all the time increasing in fertility, and becoming each year better instead of worse

There will be various modifications of this system, according to the quality of the land. Sometimes the wheat crop is omitted, and another crop substituted, but on all the best lands of England this course can be followed with impunity, and without deterioration to the farm.

Now, let us see whether we in Canada cannot do likewise: and if not, what we can do —The first objection is that from the shortness of the straw, and the small quantity of hay grown per acre in Canada, no farmer has as much manure as he wants; and if he had it, it is but too often the case, that being made out of doors, and having been frozen all winter, it is not rotten, and if it were, he has no time in the spring to carry it out, and he therefore defers his operations with manure till too late in the season. The chief complaint, however, is that he has not enough manure.

Secondly—That wages in Canada are too high to allow of the extra labour required by large crops of turnips, and that capital is too limited to allow of large quantities (if raised) being fed off with sheep; because sheep require to be housed in winter, and turnips also require housing, and that no buildings which can be met with on ordinary farms are extensive enough to house all the roots which could be grown on one-fourth of the arable land of the farm. In addition to this, the difficulty is presented of carrying all the turnips to the barn, and then removing the manure to the field, thus moving the turnip crop twice instead of once.

Thirdly—That farmers cannot afford the cost of forty dollars per ton for artificial manures, and cannot grow turnips in large quantities without them: and besides, they think they cannot afford the cost of hand-hoeing large crops of turnips. Before proceeding further, let me say what I consider a large crop of turnips to be. I have often talked with Canadian agriculturists about turnips. They say "Oh yes," we grow turnips, we could not get along with the stock without them; why we raised over *six acres* of turnips last year, and had a capital crop." And these people farmed from eighty to one hundred acres of cleared land. Now, I call that no crop at all. Such men ought to grow from twenty to twenty-five acres of turnips each year; and so I tell them. "Yes," they say, "we would if we could afford it; but we have neither sheep nor cattle to eat them, nor have we the means of housing them or the labor to cultivate them." The latter is probably the most cogent reason. There is also amongst farmers great difference of opinion as to the money value of turnips for feeding stock. One highly successful farmer rated them at fifty dollars per acre, and said he always charged his fatting cattle with that amount. Another of equal pretensions considered them dear at five cents a bushel, to feed to cattle, and both were ready to back their opinion by argument to any extent. Both, however, agreed on the value of the manure resulting from the turnips, but both calculated to feed them to housed beasts, and to carry out the manure afterwards. Here the same difficulty begins again. We have first to carry the turnips to the beast, and then the manure to the land; and if other land wants it worse than the turnip land, or is nearer, it gets it, and the turnip land goes without, and is impoverished instead of being benefited by the crop.

ALL THIS WON'T DO—*We must do as they do in England, grow the turnips on the land and manufacture them into manure on the same land, or we shall not get into the right course.* But before showing how this is to be done, let us see why it is most especially required. And here I shall begin to meet with objectors, and cavillers at what I say.

Modern improvement in agricultural science has shown, that land, or ground, or soil, let the quality of it be what it may, is the mere vehicle for holding the roots of plants—it may or may not contain the element we require for growing a particular crop—if it does, so much the better, we can get the crop without extra expense on that score. If it does not, science shows us what it wants, and by adding that material, or those particular elements to the soil, we can make it answer to our will, and grow the particular crop we want, provided the season is favorable. A Frenchman, Mons. Ville, takes sand, he heats it red hot, so as to burn all vegetable matter out of it, he then washes out everything that is soluble, and has for the residue a substance in which nothing can or will grow. By dint of numerous and constant experiments, however, he has ascertained that by adding the elements of phosphate of lime, carbonate of potassa, quick lime and nitrate of soda, in certain proportions, (and all in the shape of pure chemical salts), he can bring this burned sand to a state of prolific fertility which will produce any crop that he may please to sow upon it. The crop he may sow (according to its nature) extracts certain of these elements; and to keep up its fertilty for the production of another crop of the same nature, those elements must be added the following year. The proportions he gives will keep up the fertility of his burned sand for four years, provided the necessary element of plant food is added which has been abstracted by the previous crop. After four years, a fresh fertilization of all the original elements must be added, and then full fertility is restored; and in this way he has kept his burned sand in full heart, and capable of producing excellent crops for ten years.

This most valuable experiment, therefore, proves that (all questions of seasons and expense apart) the agricultural philosopher can do what he will even with the most barren soils, and shows us that none need despair over the most sterile spot, provided they can supply the elements required at a sufficiently cheap rate.

Now, our usual and average farming land all through America, contains within itself nearly all the elements which the Frenchman added to his burned sand; but most soils are deficient in some one of the required elements, and hence the smallness or failure of our crops

Plants also, when considered as abstractors from the soil, must be divided into four families—namely:

1st. *The Cereals,*—such as wheat, barley, oats, Indian corn, and Timothy grass. These abstract chiefly ammonia from the soil; and to meet their requirements, ammonia must be added.

2nd. *Leguminous Plants,*—such as peas, clover, vetches, and all papilionaceous flowering plants. These abstract potassa, or the element of potash, from the soil.

3rd. *Roots.*—such as turnips, mangels, mustard, radish, and all cruciform flowering plants. These abstract the phosphates; while some, as the beet root and mangel, abstract largely the potash as well.

4th. *The Grasses*—and those plants which form the natural herbage of untilled soils. These (as abstractors) are not so well understood. They will always grow in greater or less quantities, and they, therefore, doubtless are satisfied with a less amount of a particular element, and draw on the soil more moderately, whilst, as we all know, they are natural fertilizers, and must obtain from the air *more* than they abstract from the soil, and are, in fact, natural restorers of what man has robbed from the ground. But we must also consider these four families of plants not as abstractors only, but as restorers to the soil. Each of these families, in addition to abstracting their special element in large quantities, extract all the other three elements in smaller quantities, and if what they abstract is not returned to the soil in some shape, the soil after a time becomes barren of that element, and the crops which require the special qualities refuse to grow. There are also some minor elements, native to all ordinary soils, but they are taken up in such small quantities that we shall not notice them.

In a state of nature, land restores itself to its ordinary state of fertility. Any particular plant most suited to the soil takes possession of it, and continues to grow until it has taken from the soil its own particular element. This it abstracts by its roots. If the plant decays on the surface of the soil, the element, abstracted from considerable depths, is restored to the surface; and if the plant which formed the deposit possesses roots which seek its food in the depths of the soil, and not on the surface, that plant gives way before another, which takes its principal food from the surface, and not from the subsoil. This is shown in Canada on a large scale in the growth of the forest. Where we cut down pines on land formerly covered with them, various kinds of hardwood, but principally the oak of several species, succeeds; after the oaks have run their course, there is little doubt that the pines would again naturally follow. In the vast plains of South America, the land of clover and all kinds of succulent grasses, and not of trees, and where the extensive savannahs and plains sustain innumerable herds of cattle and horses, this same principle is carried out in a most marked manner. Millions of acres of clover and the most succulent herbage spring up and attain the most astonishing perfection. During this period these plains are covered with countless herds of cattle, sheep and horses. By the time the crop has attained perfection, a large species of thistle (which, like all its tribe, sends its roots deep into the soil) has attained a considerable growth. It then shoots into its seeding stalks, and foliage, and takes entire possession of the soil. These stalks grow to six or eight feet high, and with startling rapidity. As soon, however, as the thistle attains a certain growth, the plains are deserted by the cattle and horses, which fly to other pastures. The thistle flowers and comes to perfection, and for a season remains, forming an impassable barrier to all travel, except on beaten roads, until the winds and rains of the winter, or rainy season, cause their decay and disappearance. This is followed the succeeding spring by a new crop of clover, and grass, and fresh pasturage. Again the plains are covered with animals, to be again driven off by the recurring thistles, and so the circle of fertility is kept up. How long it lasts before it is succeeded by other growth, has not been observed, but it is doubtless subject to the same laws of nature as the soil more under our own immediate observation.

The object of nature is to restore things annually, thus leaving the soil at the end of the season as fertile as it was at the beginning, although the fertility may be of a different kind. But the object of man is, to abstract for his own individual profit: and he will not restore until nature, asserting herself and her requirements, obliges him either to do so or to abandon the land. Many requirements lead chiefly to the growth of the cereals, all other things must bend to these requirements. Roots and grasses produce meat and fatty matters, but the growth of these matters are always subservient to the growth of the cereals.

Unfortunately, however, the cereals abstract certain important elements from the soil, and the centralization of man in towns and cities, and his peculiar habits, prevent the restoration of those elements; those, particularly the phosphates and the other mineral elements, are not allowed to return to the soil from whence they were taken, and to keep up the circle of fertility they must be restored artificially; for this cause we search and ransack the world for phosphates, which are restored to the land in the shape of bones, guano, poudrette, super phosphates and other artificials of that nature.

But although important and necessary to the cereals, the phosphates and other similar mineral matters do not by any means form the only, or most important, element for the growth of grain. The cereals require ammonia, and must and will have it, or they will not grow or produce The phosphates are secondary, though necessary; but ammonia and its producers are primary, and will not be spared by the land.

Now, the cereals, like all plants, take a certain amount of ammonia from the air, but they require more from the earth; and in the course of their growth they abstract far more from the soil than is held or remains in the crop. This is not the case with other plants. The Leguminous plants, and the roots, such as the turnip, mangel, &c., abstract large quantities of ammonia from the air, which instead of again imparting to the air, they retain within themselves. Hence the benefit of feeding off these classes of plants on *the soil on which they grew.* Their results supply what the cereals want, and furnish the ammonia necessary for their productive growth. It is this cause which makes turnips and root-growing profitable to the farmer The phosphates produce the roots in full perfection; the roots, *when consumed on the soil* (but not otherwise), return the phosphates, with a large amount of ammonia which they have derived from the nitrogen of the atmosphere, and the result is a good crop of cereals. But if, instead of the results of the turnips being restored to the *same soil from which they were taken,* they are applied on other land, the turnip land is the poorer instead of the richer for the crop, and the end for which the roots were grown is not attained.

Now, in Canada, whatever any one may say to the contrary, profitable farming consists in wheat growing, or the growth of some corresponding cereals. These articles form our export, and without them farming becomes unremunerative. If we can grow these articles, and grow them well, all other productions of the farm follow as a matter of course, but the cereals *must be had* or the farm cannot go on.

[The remainder of this article must be deferred to another issue.]