to be a practice of sowing a crop of grain every five or six years, to work out the dung," as the owners called it The *quality* of the produce seemed to be improved by it. I should like to know if any of you have ever met with this practice.

In the extensive melon grounds round Montreal, it has often struck me that, where the place is much exposed to the wind, a belt of Indian corn, sown early, would afford a good deal of protection to the crop, and prevent the vines from being blown about so much. Shelter from wind, in a high lying place like Montreal, is worth more than some people imagine.

Would not the deep trenching—a costly operation, I know—save the vegetable gardens from burning up in our hot Canadian summers? I need not tell you that the practice is universal in England, but I never saw it done here, and I have often wondered why it is not followed. If it answers at home, in our dampish climate, would it not answer still better here?

Try a dressing of nitrate of soda for your tomatoes, you who grow them on the *single stem* plan. It will not answer where the plant is allowed to run wild, as it has a decided tendency to produce unlimited growth of stem and leaves.

WASTE OF MANURE.

The following extracts from the Vermont Watchman, on the "Waste of manure on a hillside," will be read with interest by all unprejudiced minds. Our readers will please to remember that Dr Hoskins, the agricultural editor of that paper, is a thoroughly practical farmer and nurseryman, and that nothing coming from him is to be regarded as the mere evanescent impression of one not accustomed to weigh matters with nicety.

DO WE LOSE MANURE.

BY EVAPORATION, BY WASHING AWAY, OR BY LEACHING?

Agricultural Editor: — As no one has volunteered to answer Mr. Thomas's question as to the advisability of spreading manure in the fall and winter, I venture an opinion based on experience. Our soil is not clayey, but a stiff loam. I once spread manure on a piece, early in the winter, that was ploughed the fall before. It was frozen and partly covered with snow and ice. It sloped towards a run and seemed a very dangerous experiment, so much so that I left a strip next to the run without manure, to be enriched by the manure washing from the land above. When the snow was melting away in the spring, the colored water was seen coursing down to the run. The whole was sown to oats, and at harvest time we had a beautiful piece of grain where the manure was spread, but not the least sign of benefit from the manure appeared on the strip below. No one can go through the world with his eyes open and not see that the fertility of the soil washes toward the low land, but the waste is so slight that no one need hesitate to draw and spread manure any time before the pressure of spring work. I used to think that manure must be plowed or harrowed in as soon as it was drawn to the field, but I have got over that; it don't lose much but water, and that is generally cheap. Do we lose as much fertility by leaching as we are accustomed to think? I have moved off two sets of old fashioned farm barns, expecting to find a mine of wealth under them, but in both cases I have been disappointed. The land needed enriching very soon. As we draw manure from the barn cellar I look with some anxiety at the liquid manure in the bottom of the heaps. Does it go down, or does it form a salt and so get carried to the field? Well, how differently we do look at things! While Bro. Brook of South Newbury is mourning for the good old fashioned clover, I have been comforting myself with sowing grass seed thicker and getting a good yield and a better feeding quality of hay. I. N. P.

I. N. P.'s article, in another column will interest a great many of our readers. He asks a number of important questions, and we hope to see them well discussed by our practical and experienced farmers on various kinds of land and under varying conditions.

As to the waste of manure on a hillside, we have a large and long experience, which has taught us that while there is a little waste, it is much less than we would expect. Our market garden at our old place slopes to the south about two feet on a hundred. It has been under the plow now for upwards of twenty five years, and has been manured heavily nearly every year. The crops have been onions, beets, tomatoes, early peas and beets, with winter squashes to succeed the earlier crops as they were taken off.

BELOW this garden of rather more than an acre is a steeper slope of some fifty feet wide down to a piece of wet meadow. Before the garden was commenced very little grass grew on this steep part, but after a few years of the above treatment to the garden the grass below began to improve. Part of this improvement was perhaps due to the mere wash of fine soil; but of course, as the case is, some fine portions of the dressing, or of a watery solution of fertilizing material goes down the slope. But the gain was not very rapid. Yet, for now a dozen or fifteen years, we have cut very heavy grass on that bank, where originally only a little plantain, all-heal and June grass appeared. This, remember, is on quite light soil, which experience shows not to hold material matter so strongly as clay soil. The heavy annual dressing gives a good garden crop, and what is washed down gives a good grass crop, although it took some years to make the last fact conspicuous. We hope this subject will be fully discussed by our readers, for it is matter of great practical importance.

Science.

PLANT FOOD

By D. P. Penhallow.

APPROPRIATION OF FOOD.

In our last number it was ascertained what elements of plant food are derived from the air, and the character of the organs through which this food enters the plant. We now have to turn our attention to those elements derived from the soil, which, as already seen, far exceed in number, those obtained from the air, and preliminary to this it will be desirable to make a brief inquiry into the structure, distribution and specific action of roots in the performance of the work assigned them.

ROOT STRUCTURE.

If we examine the root system of a bean one or two weeks after germination, we shall see that proceeding downward from the original seed is a strongly defined axis—the axial or tap root—from which are developed numerous branches, the whole bearing a somewhat marked resemblance to the trunk and branches of a tree turned upside down. Roots of this type are commonly characteristic of those plants which are termed exogenous, such as may be found among our common trees and also among root crops such as the carrot and beet. If on the other hand we similarly examine the roots of seedling wheat, it will be observed that there is a total absence of a central axis, and that all the various divisions of the root system arise from a common point of attachment, the base of the stem, and, presenting as they do, the appearance of a mass of fibers, constitute the so called fibrous root system of the endogenous plants. Such a root system is therefore commonly found in the grasses, including our common and well known forage plants, corn, bamboo, sugar cane, sorghum, &c. These considerations are of primary importance because, as will appear presently, plants sustain very different relations to the soil according to whether they have one or the other of these root systems, and the methods of tillage applicable to one, will not answer as a rule for the other.

If now our young roots are permitted to grow in water containing a certain amount of nourishing matter, under such conditions that with all the members growing freely, their various parts may be examined, it will be noted that near the extremity of each growing root there is what appears to be a fringe surrounding it on all sides. This fringe does not extend quite to the very tip, but commencing a little way back, it extends towards the older parts of the root possibly for a distance of one-half to two inches, where it suddenly terminates. If this fringe is examined with a glass capable of magnifying about ten or twelve times, it will be seen to consist of a multitude of fine, hair like outgrowths from the surface of the root. If these are again placed under a more powerful microscope, magnifying about one-hundred times, each filament will then be seen to consist of a slender, tubular hair which grows directly out of a cell forming part of the outer membrane or epidermis of the root itself. These structures, then, from their origin, are known to botanists as epidermal hairs, and otherwise, on account of the organs on which they occur, as root hairs. Minute and apparently insignificant as these organs are, they are nevertheless of the greatest value in the plant economy as we shall soon have occasion to learn.

It has been stated that these root hairs (1) do not quite reach the tip of the root and (2) that they terminate abruptly at a short distance back of the growing tip. The first fact noted is caused by the skin or epidermis being in an unformed or incomplete state, so that that point nearest the end of the root, at which these hairs first make their appearance, indicates the full maturity of the epidermis. On the other hand, it is found that the epidermis of plants is always liable to be removed sooner or later, by the formation beneath it, of a layer of cork tissue, a structure which is exactly represented by the material out of which the stoppers of bottles are commonly made. Such cork tissue is, however, a dead structure. It is commonly formed for purposes of protection whenever there is an injury, or where, in the natural process of growth, certain structures require to be removed from the plant system. Thus in the dropping of a leaf in autumn, there is left a scar the surface of which is invested by a cork membrane. As the bark of the grape vine exfoliates each year, protection is still given to the growing parts within by a tissue of cork formed prior to the removal of the old bark. All this necessarily points to the fact that the cork, as a dead tissue is also impervious, and, therefore, there can be no living structure external to it. Hence, as soon as such a tissue forms on a root beneath the epidermis, the latter falls away and, together with it, the hairs developed from it. It is a conspicuous feature in the structure of most roots, that their outer surfaces are covered chiefly, not by epidermis but by cork, and as this latter appears very early in the growth of any root, we have an explanation at once, of the sudden termination of the roots hairs at a short distance from the growing tip. It is important then, to keep clearly in view that as impervious cork covers the greater part of the surfaces of roots, no absorption of material from the soil can take place over such areas, but this function must of necessity be confined to the root hairs themselves and to the surfaces upon which they are developed. A failure to properly appreciate this fact has often led to curious mistakes in the application of food to plants, while its recognition will admit of these methods of cultivation which are most likely to produce the best and most immediate results.

One other fact may be noted before we leave these important structures. The root hairs are produced each spring with the renewal of growth, or in plants which are annual, they necessarily appear with the first development of roots after germination. During the progress of growth, as new roots are formed in the extension of the root system, new root hairs are constantly being thrown out, while the older ones are as constantly drying off. Thus while the number of hairs on any given root branch remains tolerably constant, the whole number will necessarily increase with multiplication of roots, and in this way the feeding surface is augmented as the plant increases in size.

At the close of the growing season, all the root hairs perish, and the time when this change occurs is indicated in perennial plants, by the shedding of their leaves. From this time on, until the return of higher temperature in spring, the plant in all its parts remains dormant.

A recapitulation of the leading facts thus considered, shows that:

(1) According to their form and distribution of members, roots are
  (a) Axial
  (b) Fibrous.

(2) The principal surface of roots is covered by impervious cork which prevents absorption of food and water over such areas.

(3) The absorption of food and water is confined to the root hairs and the surfaces from which they grow.

(4) The root hairs are confined to very limited areas near the growing extremities of the roots, and while they are always present during the season of growth, they disappear at the end of this period.

DISTRIBUTION OF ROOTS.

By distribution of roots we mean to imply their relations to the soil