## THE SOIL

By A. T. WIANCRO, B.S.A., Sparrow Lake, Ont In order to secure the largest possihle crop yield that our soil is capable of giving us we should see that it contains a sufficiency of moisture for all plant requirements, but no stagnant or surplus water should be allowed to remain in the soil above a reasonable depth for the development of plant roots Ordinary field and garden crops cannot grow and thrive in soll that is saturated or filled with water.

By drainage we mean the removal of the surplus water from the soil, either by natural or artificial means A properly drained soil is one that is moist but not saturated with water Loose, sandy, or gravelly soils, and those with an open or coarse subsoil, are said to be naturally drained All heavier soils, and those lying in low places, require artificial means to remove their surplus water, and hence should be under Irained.

Soil is composed of exceedingly small particles of various shapes, which touch each other, leaving various sized small spaces between. By the law of physics, known as surface tension, each particle is covered by a film, or thin layer of water, which it holds to itself over its entire surface. The remaining space is filled with air. Where there is an excess of water the air is excluded --the water taking its place This should not be, as a soil without air cannot sustain plant life. Where an outlet is provided all surplus water will pass off by gravitation, leaving only the amount held by the particles of the soil, which will not pass off as drainage, but remain to supply the needs of plant growth. The amount of moisture that can be held by surface tension will depend upon the fineness of the soil particles-a fine clay soil will hold more than a coarse sand. The food which plants take through their roots must be in solution, and the water held by surface tension is sufficient for this purpose. All the water in excess of this is unnecessary and injurious, and should be removed by underdrainage.

Manyotherwise excellent agricultura lands are unproductive or do not produce all that might be expected, because they contain too much water. Whether this excess of water comes directly from the rainfall or from soakage of adjoining lands, it must be removed by artificial drainage before such lands can be productive to their full capacity. Undoubtedly there are many soils that are not absolutely in need of underdraining, but unless these are of a very open texture they would, nevertheless, benefit in many ways by being so treated.

The main advantage of underdraining lies, of course, in the removal of all surplus water that may find its way into the soil. Aside from this a great many advantages are derived from the fact that in removing the water it is first passed down through the soil. Rainwater, being of a higher temperature than the soil, thus imparts its warmth to the soil, which is no small consideration in hastening the germination of seeds and making all plant growth more rapid. In a well drained soil the frost comes out earlier in the the farmer than any other animal, and, leading from the factory were filled spring, and the land dries up much perhaps, than any other thing he can more rapidly and is fit for cultivation put his hand to.

ADVANTAGES OF UNDERDRAINING much earlier, thus lengthening the season of growth, which is an important point in our northern climate. Undrained lands are often too wet for planting until the proper time for such planting is past. We can thus see that good drainage may in many cases make a difference of several weeks time. In order that growth may proceed rapidly the soil must be warm. A wet soil is always cold, as its natural warmth goes towards evaporating the excessive water. In passing the water through the soil the surface is left entire; the fine, rich particles are not washed away as is the case where the water flows over the surface. Water in passing through the soil carries down with it, and incorporates more closely with the soil, any fertilizing material that may be deposited on its surface, thereby bringing it within easier reach of the roots. Rainwater in failing through the air carries down

> with it considerable of fertilizing material which the soil filters out and retains, leaving the water to flow off clear. Water in percolating through the soil makes it more open and porous. This is especially advantageous in heavy clays, so that plants can penetrate to a greater depth and spread through a greater extent, thus providing themselves with better facilities for gathering food and moisture.

In periods of drought the danger of insufficient moisture is materially less ened as the power of the soil to absorb rain and dew is increased through better capillary movement, thus spreading through the soil what moisture may be available. If water is flowing through the drains from a better watered section it may be drawn out by capillary This proattraction where needed. cess of capillary attraction is well illustrated in the passage of oil through the wick of a lamp. We can see, too, that in periods of drought water may thus be drawn toward the surface from a considerable depth. A soil that is usually water-soaked, when it does dry out will bake and crack open, and dry out much more thoroughly; while a well underdrained soil can never bake, and under similar circurstances will always be found moist because, being porous, there is a continuous supply of moisture coming up from underneath to replace that which is being evaporated by the heat of the sun.

It is very interesting and often surprising to notice the increased crop yield derived from a field after it is well underdrained. In many cases the yield will be doubled, and the expense of underdraining more than repaid by the increase in the crop of a single season.

In conclusion I would say to those contemplating underdrainage, that it is of the utmost importance that the drains be well laid out and the whole of the work carefully and thoroughly done, for on this alone will depend the durability and future utility of the drains. A man who has not himself had sufficient experience would do well to employ a careful and experienced workman to superintend the job, or else consult a good book on the subject.

The hog will turn money faster for

## FARMING

## BACTERIA AND DAIRYING.

Part of an address by Dr. CONNELL at the Butter and Cheese Convention, London, Ont., Jan., 1898.

There are classes of bacteria which find in milk and milk products their but here in the gutter was cause natural habitat, and which bring about many changes, which we are accustom ed to look upon as natural, such as acid production, souring, curdling and the like. But besides this class of changes we will at times find certain cheese and the slimy growth in the others which we do not so look upon gutters, identical bacili, which I think as natural (though in reality as natural as the first set), such as had flavors, bitterness, curdling without souring, the coloration of milk or cheese and such like. Now the vast majority of such changes are brought about by bacteria, and though usually the souring organisms get in and obtain the upper hand, yet in the case of the changes which we look on as unnatural, we but have some other species getting the upper hand and outmultiplying the others. If we could keep milk free from microorganisins we could keep it sweet in in all more particularly in the wheys vast definitely. But we cannot obtain such numbers of a large bacillus which I have milk in the ordinary process of milk- since proved capable of producing ing, for bacteria are found in the milk both slinly milk and whey. Of course ducts of the udder, on the teats and udder, the sides of the cow, the milk- directly from stables, etc., but I think er's hands and in stable dust. fortunate that the bacteria which bring of the trouble is an important factor about the desirable changes in milk, butter and cheese are widespread and are, in the great majority of cases, able to bring about the desired changes. They live in milk and milk products my experience with the milk furnished and will naturally be found in greatest the Kingston Dairy School this past numbers near their food. I have been two years is concerned, is by a certain told that in our Northwest, when a series of micro-organisms always found dairy is started in a new section, in the offal of animals and hence in the milk often keeps sweet from three stable and road dust, etc. days to a week in weather that would micro-organisms are known as the here cause milk to sour inside of 24 hours; later on, however, their milk sours just as rapidly as ours. With the great multiplication of dairies there has been a corresponding increase in sides of the cow. the numbers and distribution of the often large enough to be visible as can bacteria that live in milk. But with readily be seen by examining the milk the increase in the number of dairies cans. Besides this direct means of it has become, if anything, more difficult to produce a uniform grade of butter and cheese. For with the increase of the desirable forms of bacteria there has been an increase of undesirable forms as well. These forms have their opportunities, growth and multiplication in the whey tank and gutters in the drains, in uncleansed milk cans and milk utensils, in uncleaned floors and in what we call filth everywhere. Undesirable bacte-ria which are so apt to be found in offensive whey tanks and in uncleansed gutters may obtain entry to the factory and seed the milk in two ways. First by coming in contact with the dairy utensils either directly or in the form of dust by drying up and blowing about, or secondly, by being taken home in the milk cans in the whey or skim milk, and if these are not thoroughly cleansed then the bacteria left colon bacilli in vast numbers and on behind multiply in the fresh milk introducing these into fresh milk we placed in the cans. One patron can could get a floating curd with the in this way seed the entire supply. typical odor. Another feature about in this way seed the entire supply. Often both methods are at work. In a factory in Leeds county the cheese milk was that the cheese did not cure. were found to show some ten days I have found other organisms than the alter being made very numerous reddish spots. I was asked to look into cheese. In several cases these bacteria the matter and found that the gutters with a slimy reddish growth, a vast This leads me to speak of another culture mass of bacteria. The edges matter, viz.: The effect of the temper-

of the growth faded off into the surrounding dust to be blown about. I found nothing in the milk sent to the factory to account for the coloration, enough. The factories and gutters were carefully and repeatedly cleansed with the result that the spots entirely disappeared. I should have said that I recovered from the spots and the proved the gutter to have been the cause of infection.

Now to illustrate infection through whey tanks, I will cite you a case occurring in Glengarry county last summer. Here they had sliniy or stringy whey, and Mr. Ruddick was asked to look into the matter. The trouble was intermittent in character, appearing for a few days and then disappearing for a week. He sent me samples of the cheese, of the slimy whey and or the whey in the storage tank. I found I have not here excluded infection It is the fact of the intermittent character in believing the whey tank a great agent in keeping the trouble alive.

Another source of contamination and a most marked one in so far as These colon group of bacilli. The most common means of contamination is by particles of manure falling directly into the milk pail from the udder or These particles are infection with this group of gas forming bacteria, stable dust and road dust, both of which are loaded with minute particles of excreta, are sources of contamination. Direct infection plays the most important part in winter dairying, while dust is the most acute agent in the summer months. Now I have time and again proved the relationships between the varieties of colon bacilli and pin hole floating curds and many foul smelling milks. One of the best marked cases I have seen occurred in February last at the Kingston Dairy School. The curd for a few days was very foul, and on examining the milk samples, one particularly foul sample was found. This patron's milk was made up separately and gave a floating, foul curd. I readily separated from the milk the various curds and the cheese a this cheese made from this patron's colon varieties in cases of bad flavored belong to the micro-organisms of putrification.

This leads me to speak of another