

very comfortable, or convenient and suitable, medium for the germination of the seed and the growth of the young and tender rootlets and the extension of the root system. It must also be well aerated, and it must hold moisture. We have, in a soil rich in humus material in the soil, all these functions, the bringing of the soil into a right condition of tilth; humus or semi-decayed organic matter makes a soil a comfortable medium for the growth of crops. We have to house our fowls and our live stock. It is the same with our crops. It is not merely the shelter and food that is essential, but we must have the soil comfortable for them to live in or they will not thrive.

BIOLOGICAL EFFECTS OF HUMUS.

Then there is another matter: humus supports the microscopic life of the soil. We understand now from recent researches that the soil is crowded with microorganisms, bacteria, and these perform a very useful function. Their prime function is to convert unavailable plant food into available forms for crop use. They feed on this humus-forming material, provided the soil is warm, moist and well aerated. The more vegetable matter (humus) we can give them the more they thrive and develop. It follows that the more available plant food we have in the soil the larger will be our crop yields, speaking roughly, other things being equal. So it is evident there are many useful functions that this humus material has to perform in the soil. Apart from the purely chemical one of plant food, it has a biological function in supporting the life of the soil, and it has the physical function in improving the tilth. These are the reasons why we say that manure has a greater value than might be indicated, by its percentages of plant food, and that is really the fundamental difference between manure and fertilizer. Manure furnishes a large amount of this humus-forming material; and, more than that, it supplies with it the elements for these soil bacteria to live on and to transform into food useful for farm crops.

MANURES ON MUCK SOILS.

Farm manures are teeming with bacterial life, and it is for this reason chiefly, I believe, that we have found it a successful practice to apply manure to muck soils. Muck is very largely semi-decayed vegetable matter. It looks like carrying coals to Newcastle to put more organic matter on such soil, but nevertheless we do find that even small amounts of barnyard manure are very useful at the outset in reclaiming these muck soils. Why? Partly because the plant food in the muck is not in an available condition, and there is a certain percentage of plant food in manure in an active, readily soluble and available condition. I believe, further, that the value of manure follows from what we may term an inoculation of the soil, the seeding of that soil with germs, with bacteria, and these cause a further breakdown of the components of the soil that will render the plant food of the muck soil available for crops. Consequently we believe there is a strong line of demarcation to be drawn between manures on the one hand and fertilizers on the other; this knowledge will make plain to our farmers why manure is undoubtedly, and must necessarily be, more effective than fertilizers.

FREQUENCY OF APPLYING MANURE.

The next deduction we made from our work was that there is a value in frequency of application. The reason for that is this: There is a natural destruction or dissipation of the organic matter in the soils from oxidation and chemical reactions following the tilling, the cultivation of the soil, which results in the loss more or less of this organic matter from the manure. We have found, for instance, that when we first till our rich soils in the Northwest, there is for the first five years or so a very heavy destruction of humus material. As we proceed we reach a minimum, or at least a limit, below which the destruction of the humus becomes slower and slower.