According to this an ideal crop of wheat could be grown yearly for 70 years before the supp'y of nitrogen would be exhausted. By the same cropping the phosphoric acid would last 115 years and the potash 200 years. But these represent the fertility in only the first foot of soil. Many of the roots penetrate below this depth, and, as the rain annually brings down to the soil from six to ten pounds per acre of nitrogen, it would seem that the fertility of the soil is practically inexhaustible. But the writer recognizes the fact that soils do wear out, and explains it as follows :

In the first place, only a small portion of this plant-food is ever available to the plant at any one time. Nearly all the nitrogen, for example, exists in the form of organic matter, which cannot be used until it undergoes the process of nitrification, the process by which the nitrogen of organic matter is converted into nitric acid and nitrates. Nitrification takes place by means of bacteria, which live in the soil. In order that these bacteria may thrive and perform their work well, they must have conditions of warmth and moisture, must be supplied with oxygen, and the acid formed must be removed or combined with some base. Quite often a base easily acted upon is not present and too much free acid accumulates. Then, too, in watterlogged soils the temperature remains too low and the air is excluded by the water. We must find some way to supply these necessary conditions.

But there might be plenty of available nitrogen and the soil fail to produce well on account of a deficiency in available potash or phosphoric acid. These elements exist in the soil in nearly or quite insoluble compounds ; the potash in combination with other elements form double silicates, while the phosphoric acid is in combination with various bases which form insoluble phosphates. They may be liberated from these compounds and brought into solution by means of humic acids formed by the humus of the soil, by means of water holding in solution other salts, and by the action of the fibrous roots of plants. But, under the most favorable conditions, it has been estimated that less than one per cent. of these elements could be brought into solution in one year's time; and when once once brought into solution their tendency is soon again to form insoluble compounds. Granting, however, that an abundance of these three elements exists in available form, soils may fail to produce because they lack the necessary water to carry this food to and into the plants. The chief means by which these difficulties may be overcome is good tillage. There is no other way by which so much plant-foot can be liberated as by thoroughly pulverizing the soil :

Good tillage loosens the soil and allows free circulation of air. It may often aid in hastening evaporation for a time, and it also allows the sun's rays to have more power on cold "soggy" soils. As above stated, all of these conditions promote nitrification. Thorough tillage reduces the soil to fine particles, upon which water and humic acids may act more readily, and by breaking the surface crust, which always forms on untilled soil, makes more room and better conditions for the development of fibrous roots. It is a well-known fact that roots grown in a hard, crusty soil do not have as many fibres (which are the chief feeders of the plant) as those grown in soil or looser texture. It is also true that, though our cropping-plants send many of their roots to a greater depth, the major part of their feeding is done near the surface. These facts suggest that good plowing is one of the most essential features of good tillage.

Farming.

A LAST WORD ON APPLYING MANURE.

Although there may be some cases where the land is very level and where circumstances are such that the only way to manure may be during the winter, such instances in my opinion are very rare. My experience has covered many different kinds of soil and in different states. I have known of many cases where large coats of manure plowed under in a careless manner were, during dry seasons, a detriment to the crop, but when the work was properly done I never knew of any harm coming from the practice. The main reason why manure should be put into the soil and thoroughly mixed with it, is that it adds all the humus directly to the land.

In reply to W. J. Bradt, I would say that the principle applies as well to sandy or gravelly soils as to clay, and in fact my last six years' experience has been with the light, sandy soils of central Wisconsin, and I would venture to say that there is a loss of 20 per cent of the value of eight out of every ten loads of manure ever spread upon frozen ground unless the land be an absolute dead level. The best farmers keep their manure either in manure cellars under their barns or in