

From the data presented it is evident that the amounts per acre of mineral plant food of immediate agricultural value are very small, compared with the amounts of total plant food present. Nor must we suppose that the whole of these supplies—small as they are—can be secured by any crop, for its root system occupies necessarily a more or less restricted area and does not envelope every soil particle. A poor physical condition of the soil and lack of sufficient moisture are factors that still further prevent the utilization of this available plant food. One of the chief functions of mechanical processes for disturbing soil is to hasten the conversion of inert material into these more valuable compounds. The principal object—indeed, in most instances the only object—in applying manures and fertilizers is to add to this store of available plant food. The quantity of soluble food so added is insignificant, compared with that already present in an insoluble state, but the increased yields resulting, fully corroborate the statement that a soil's productiveness should be measured by the amounts of its plant food which are more or less available, rather than by the amounts of that shown by extraction by a method of analysis employing strong mineral acids. This view can scarcely be unduly emphasized; it explains, as we shall see, in a large degree, the value of the clover crop as a fertilizer, which we shall now consider.

We have already mentioned that the legumes—of which clover is a prominent member—have a source for their nitrogen other than and additional to that present in the soil. Like other plants, they are unable to absorb free nitrogen of the air through their leaves; like in other plants, that which they absorb through their rootlets must be as nitrates. In what way, then, is the indisputable fact that they can make use of atmospheric nitrogen to be explained? The careful researches of Hellriegel, Wilfarth, and other chemists have shown that the legumes obtain the nitrogen of the air existing in the interstices between the soil particles through the agency of certain micro-organisms present in the soil. These bacteria, whose special function is the assimilation of free nitrogen, attach themselves to the roots of the growing clover or other legume, forming thereon nodules or tubercles. These nodules, swarming with countless hosts of the germs, are to be found in sizes varying from a pin's head to a pea, and frequently