

wise almost unavailable nitrogen—the air. Plants cannot use the free nitrogen, but require it in the form of nitrates, and this transformation is brought about by the root bacteria found in association with these plants. This discovery afforded an explanation of the long known fact that such leguminous crops enriched the soil. Since that discovery, other bacteria living free in the soil have been found that are capable of fixing the essential nitrogen, and Hall has recently stated that “We may with some confidence attribute the vast stores of combined nitrogen contained in the black virgin soils of places like Manitoba and the Russian steppes to one of these organisms.” Humus is rich in nitrogen, and the bacterial organisms, together with the oxygen of the air, convert this into available plant food. It is owing to the nitrogen-enriching power of such leguminous crops as clover and alfalfa that they are of so great value in enriching soil which has been depleted of nitrogen by other crops. It is on this single fact that the system of the rotation of crops is based, that is, the alternate planting of leguminous crops which increase the amount of available nitrogen in the soil with crops, such as cereals, which use up the nitrogen. This rotation, therefore, is one of the most important means of maintaining the fertility of the soil. Furthermore, by the planting of these leguminous crops we are enabled to inoculate soils previously deficient in nitrogen and accordingly increase their productive power.

Recently, at the Rothamsted laboratory in England, Russell and Hutchinson have made some investigations of more than ordinary interest upon this question of the relation of soil bacteria to fertility. Subsequent to the discovery of the nitrogen-fixing bacteria, the inexplicable fact was discovered that when the soil was heated or treated with an antiseptic such as chloroform to render it sterile, the fertility increased in an astonishing manner. Heating the soil to a temperature of 70 to 100 degrees for two hours doubled the size of the crop. This fact has been known since the time of the Romans and is practised in intensive cultural systems, but the cause of the increased productivity was unknown. These authors find that this increased fertility appears to be due to the fact that when the soil is heated or treated with an antiseptic, all the bacteria are not destroyed, but larger protozoal organisms, akin to *Amœba*, which normally feed upon the bacteria, are killed. In consequence, the bacteria released from their enemies increase and multiply at a rapid rate, which results in an increase in the amount of available nitrogen in the soil.

These investigations will serve to indicate how these questions of the fertility of the soil and the maintenance of that