

be continually returned to the soil in order that its fertility may be maintained. These are Nitrogen, Phosphoric acid and Potash. In this lecture Mr. Warington discusses the character of the nitrogen-holding material in the soil under three heads, 1. Ammonia; 2. Nitrates; 3. Nitrogenous organic matter. The relative and absolute amounts in which they exist and the circumstances that control their increase and decrease are given at length. He shows that while the two former are the most readily available forms for plants, it is in the organic matter of a soil that the great bulk of the nitrogen is stored up. The accumulation of nitrogen in the surface soil takes place to a greater extent on prairie and pasture land than in arable soils; and further Mr. Warington says that "for the present we cannot, I think, affirm that soils are enriched by the free nitrogen of the air, except through the medium of a leguminous crop. A diminution of surface-soil nitrogen takes place when organic matter is in excess and air freely penetrates the soil, since the conditions are then most favourable to the growth of those organisms whose function it is to oxidise the nitrogenous organic matter. Hence, the richest soils are those most liable to waste and demand the greatest exercise of the farmer's skill to preserve their condition.

Lecture 3. Treats of a very important maker, viz. Nitrification, or the conversion of the nitrogen of the soil humus into the soluble nitrogenous food of plants. Schlösing and Müntz showed that this was due to the action of an organized ferment and Warington by experiments carried on simultaneously confirmed their conclusions. This living micro-organism has been successfully isolated and studied by Dr. Frankland, Winogradsky and Mr. Warington. The most favourable conditions for this process of nitrification are here discussed at length. Briefly, they are the presence of phosphates, a slightly alkaline condition of the soil due to lime or other salifiable base, "a liberal supply of oxygen, the absence of strong light" and a temperature about 98° F. We here find the explanation of the fact so well known, viz., that the addition of marl or chalk (carbonate of lime) in moderate amounts to a soil and especially to one rich in humus, is of great value in increasing crop yields.

Lecture 4. NITRIFICATION AND DENITRIFICATION.—The conver-