

the farmer's household than by mixing them with the barn-yard manure, and most excellent results are known to have followed this practice.

ACQUISITION OF NITROGEN.

Not only can the farmer save almost the whole of the nitrogen contained in the fodder fed to his cattle, but he can actually increase the stock of it stored away in his fields, agricultural products and manure heaps by a judicious course of crop rotation. For more than a century agricultural chemists discussed the question as to whether free atmospheric nitrogen can be assimilated by plants, but it may now be regarded as perfectly settled in the affirmative, if regard is had only to the plants of the order leguminosae, such as beans, peas, lentils, vetches, clovers, alfalfa, serradella, &c. Even the great English agriculturists, Sir J. B. Lawes and Sir Henry Gilbert, who had previously been of an opposite opinion, have now admitted that this appropriation of nitrogen has been completely proved. This acknowledgment was made by Sir Henry Gilbert at a great meeting of agricultural chemists held at Halle, in Germany, in September, 1891. Thus, modern research has confirmed not only modern agricultural practice, but also the experience of antiquity, for Prof. W. Strecker has pointed out a passage in Pliny which says: 'Lupines require so little manure that they in fact replace it; vetches make the land more fertile. Corn should be sown where previously lupines or vetches have stood, because they enrich the land.'

It is not, however, to be supposed that this utilization of atmospheric nitrogen by leguminous plants can take place upon very poor soils or upon those destitute of the inorganic constituents which they require. The latter must in such cases be supplied in the shape of potash with some phosphoric acid, as was done with great success by Schultz, of Lupitz, a practical agriculturist in North Germany. In fact, had it not been for his investigations, the controversy above referred to might have continued without results up to the present hour.

Professor König, of Münster, gives the following summary of Schultz's experience:—

'Schultz acquired the farm Lupitz in the year 1855; its soil consisted of a poor, cold, diluvial sand; the profit in working it was very small. Lupines yielded indeed as fodder tolerable results, but when used as green manuring for rye and oats, no return was obtained from them. The application of artificial manures produced good crops, but they did not pay; burnt lime showed itself to be too heating. The use of manure was more favourable, especially when fertilizers containing phosphoric acid were used at the same time. But at the best the total result was not satisfactory.'

'Shortly after Schultz acquired Lupitz, the great discovery of potash salts was made, and about 1860 they began to be produced from the mines of Stassfurth. Schultz made up his mind to try them as manure and he obtained the most surprising results. After lupines had shown themselves to be useless as forerunners of grain, they were excluded from the rotation and grown on a separate field without any manuring and alternating with sheep pasture. But the harvest on these became worse and worse until the field in question became quite lupine 'sick.' Schultz made his first trial on this field, manuring it with 500 pounds kainite per morgen (1 Prussian morgen = 0.631 acre); the sickness was at once cured, and for twenty-five years afterwards Schultz has grown lupines on this ground without interruption, always with the application of 300 pounds kainite. Schultz obtained similar good results on the ground which had received the marl, by the application of potash salts. This ground had indeed yielded well with lupines for two years after the application of the marl, but in the third year they sickened here too. When, however, 300 pounds kainite were applied here and ploughed in, the ground was cured, although an application of phosphates had not produced the desired results.

'The favourable influence which the manuring with kainite or potash salts had exerted on lupines induced Schultz to try them on grain, in conjunction with phosphates. But in this case he obtained contradictory results according to the nature of the crops which preceded the grain. For instance, while grain sowed after lupines and manured with potash and phosphates yielded very good and remunerative harvests, these were not