of clover sickness has attracted almost as much attention as the source of the nitrogen in plants, and, as far as I can see, both are likely to form subjects of inquiry for a long time before the final solution of the problem will be arrived at. Although clover sickness has occupied our attention almost from the commencement of our experiments, for a long time we hardly advanced beyond the fact that no combination of manures, natural or artificial, would cause clover to grow upon land which was clover sick. Of late years, we have gathered two or three scraps of knowledge which have enabled us to mount a step or two up the long ladder on the top of which is the problem.

In the first place, we have grown red clover continuously for 35 years upon an old garden soil without the application of fresh manure. The soil and sub-soil to the depth of 18 inches was exceedingly rich in nitrogen, and it is evident that dung in large quantities had been trenched to this depth into the soil. The top soil has lost an enormous amount of its nitrogen, but it is still very much richer than the soil of the farm. The sub soil, in fact contains much more nitrogen, even now, than the surface soil of the farm. This large reduction in the fertility of the surface soil is contrary to what takes place when red clover is grown on the farm, although the crops grown are made into hay and carried off the land; and even when the roots of the clover are, as far as possible, picked out of the soil, we still find an increase of nitrogen to have taken place.

Although the crops of clover grown on this garden soil are equal to, if not larger than, those grown on the farm, they are very inferior to those grown in the earlier period of the experiment. At first the clover did not require to be re-sown for four or five years, now it is re-sown every alternate year. We have evidence here that, while red clover has been grown for 35 years without the appearance of disease, on the farm it is hardly safe to repeat the crop until from eight to twelve years have elapsed since the previous crop was grown.

We have a field which has been under experiment for nearly 40 years. Part of this field received no manure during the whole of the period. Another part received mineral manures (phosphate and potash), and a third part has been very highly manured with rape cake, salts of ammonia, and minerals. Turnips are grown, or rather an attempt is made to grow them, every fourth year, but the unmanured turnips grown with mineral manures yield 8 or 9 tons per acre, and the highly manured turnips yield over 20 tons per acre. Upon one half of each experiment all the turnips are carried away, and on the other half they are cut up and plowed in. The wheat, barley, and clover or beans which are grown during the other three years of the four rotation crops, are all carried off.

The soil which has only received mineral manures, and from which the turnips, as well as all the other crops grown, have been removed from the commencement of the experiment in 1848, must be, so far as organic matter and nitrogen are concerned, in a very impoverished condition. Where the turnips were plowed in once in four years, the condition of the land would be a little better, while upon the highly manured land the soil must be full of fertility, with where the turnips are removed and where they are plowed in, and in the latter case the fertility would be much the greater.

In 1874, and again in 1882, we grew crops of red clover over the whole of this land which was under experiment. In both years the crop was very large. Upon the highly-manured plot it amounted to 4 tons of clover hay each year; upon the land receiving minerals it amounted to nearly 3 tons each year, and upon the unmanured land it amounted to rather more than 1¼ tons each year. We now decided to take a crop of red clover again in four years. Wheat was grown in 1883, turnips in 1884 and barley in 1885. The clover was sown in the spring shortly after the barley. There was a very good plant upon all the plots during the autumn and winter, but in the spring disease began to show itself on both the highly-manured plots, being rather the worst where the turnips were plowed in. As is usual in these cases, the plant died off, bearing bare patches. Sometimes considerable strips were not attacked, in which case the plants that remained were very strong and vigorous, and the yield of hay in two cuttings amounted to 1½ tons per acre. It is probable that more than one-half of the crop was destroyed. On the two lands which had received mineral manures, and where the turnips and all the other crops grown had been removed since the experiment began, there was no disease whatever. On the portion where the turnips were plowed in there was some slight disease, though the crop appeared the most vigorous of the two; the yield, however, was slightly below the other, as the first yielded 2 tons 2 cwt. of clover hay per acre, and the other 2 tons 4 cwt. per acre. Upon the unmanured portion the plant may be said to have died of starvation, plantain and coltsfoot having taken its place. The plants that remained were barely high enough to cut with a scythe, and the whole produce, including the weeds, amounted to only half a ton per acre in the two cuttings.

The interest of the question lies now in the two manured plots. For all practical purposes the fertility of the unmanured land has been so much reduced by the removal of thirty-eight crops, that it has ceased to grow either turnips or clover. If we compare the condition of the land where there was no disease, and where the disease was the worst, we find that where there was no disease, no organic or nitrogenous manure had been applied, and all the vegetable matter grown had been removed, while the mineral manures applied contained more phosphoric acid and potash than what was carried off in the crops.

The land where the disease destroyed a large portion of the crop received, with the mineral manures, every fourth year, 2,000 pounds of rape cake, and 200 pounds of salts of ammonia, the large crop of roots and tops being also plowed in. As compared with the other soil, the soil contains vegetable matter in a different stage of decay, and provides suitable food for a great variety of under ground life. We find that the application of rape cake is followed by an immense increase of wire-worms; it is said among farmers that where the corn crops are attacked by wire-worms an application of rape cake will kill them, the fact being that they cease to eat the young corn and feed upon the cake. (1)

The analysis of the soil of these two plots shows that the land which had been highly manured contains far more organic matter and nitrogen than the other plot, while at the same time it contains very much less of these substances than the garden soil. The evidence points to a destruction of the clover plant by living organisms in the soil, a large increase in this life having been encouraged by the liberal supply of organic and nitrogenous matter. This does not however explain —supposing we have taken another leguminous crop, say beans, at the end of the fourth and the eighth year, followed by the red clover in the twelfth year—why the crop would, in all probability, escape the attack of the living agencies, and be free from disease. It is at this point that the difficulty of finding a satisfactory solution is the greatest, and it can only be met by assuming that the clover plant requires, as part of its food, a special organic compound.

It must be understood that on our experimental land,

(1) Alas! Mr. Charnock, who, in his prize essay on the "Farming of the West Riding of Yorkshire," published in the R. A. S. of England's magazine for 1850, first called attention to this fact, died at Lennoxville last month. A. R. J. F.