satisfies himself, and no doubt his readers of that early time, with the simple statement that it is so. Like the learned professor, quoted by M. Lippens, he has no doubt on the subject.

These are the statements that have misled so many people who, unfortunately, are guided by authority, who never think for themselves, and who, in consequence, are continually wandering about in search of rules to lead them. It is the often repeated story of *humus*, so long a deity worshiped by the semi-scientific farmer, which, I regret to see, is still enjoying some degree of vogue, and causing the transportation, at a vast expense, of millions of tons of bog-earth from its site to the compost heap, and thence to the land to be manured.

As M. Lippens takes red clover as a sample of the meliorating crops, I shall follow his lead, and try to show what the real effect of that plant on the succeeding crop is; to what this effect is due; and how to treat the land so that it may derive the greatest benefit from the cultivation of this, the most valuable of all our *artificial grasses*. (1)

And, first, what is the real effect of the clover plant on the succeeding crops of grain?

In England, a good crop of red clover is invariably followed by a good crop of wheat; of course I bar accidents, wire-worm, &c. An equally good crop of white-clover, trefoil, and Alsike, mixed, is *not* invariably followed by a good crop of wheat, even if the weight of the clover be the same. And, yet, the constituents of the one are about the same as the constituents of the other:

	Ash.	Albuminoids.
Red-clover hay..	6.0	13.5
Trefoil hay.....	6.0	14.6
White-clover hay.....	6.0	14 5
Alsike hay.....	6.0	15.0

In fact, white clover and Alsike are rather richer in the only two constituents that need concern us than red-clover! So it is clear, that whatever food produces the above-ground material of the crop of the different sorts of clover, the use they make of it is about the same.

But, if we look at the underground growth of the plants, we shall at once see a mighty difference. Turn to the third volume of the Journal, and on page 173 you will find two engravings, one of the Alsike and the other of the red-clover—the Alsike, by the bye, has about three times as many roots and twice as much crown as any Alsike plant I ever saw, but let that pass.—What difference do we find in the *roots* of the two sorts? The Alsike has a lot of fibrous roots, which evidently are intended to feed on the upper layers of the cultivated soil, while the red-clover has but few surface roots, but an immensely long stout tap-root fitted to descend deeply into the subsoil, and bring up thence the nitrogenous as well as the mineral riches that there abound in, practically, inexhaustible abundance. Lawes, long ago, showed, by his exhaustive experiments, that nitrogen is the impressive manure for wheat, and here we have the solution of the invariable success of wheat after red-clover.

There is, indeed, a mystery about this invaluable plant which, as yet, no one has been able to solve. No manure out of the thirty-four different kinds tried at Rothamsted seems to have any effect on its persistent reluctance to grow if sown more than once in twelve years on land that has been frequently cropped with it. As for its obtaining only a small portion of its sustenance from the soil and the greater portion from the air, that I firmly believe to be an utterly untenable proposition, except as regards the carbon, which, as a manure for the succeeding crop, is utterly insignificant in value; the air always supplying it in abundance.

At Rothamsted, every known method has been pursued to find out why red-clover will not grow continuously on the same land. On a piece of land, long cultivated as a garden, clover *was* grown, without any further manuring, for twenty-eight years in succession; but not so on ordinary farming land. In 1848, having some acres in clover, Sir John Lawes determined to apply a variety of manures to the crop, and to re-sow it if it died away. After twenty-two years, feeling tired of wasting money on several acres of land without arriving at any definite results, the experiment was restricted for the next ten years to a few square yards, and the succeeding ten years gave no more successful results than the twenty-two years that preceded them.

Again, in order to try whether the land was only red-clover-sick, or whether it would refuse to grow any other crop of the same order, Lawes sowed three red-clovers, three white-clovers, two yellow-clovers, *trifolium incarnatum* (crimson-clover), red-sainfoin, pink-clover, Bokhara-clover, and the purple vetch: every one of these had the opportunity of feeding on *thirty-four* different combinations of manures, each of which combinations differed more or less from the other. The results of this experiment, carried on during several years, is as follows: Five of the different crops grown, viz., sainfoin, tares, Bokhara clover, lucerne, and trifolium, under every one of the thirty-four different manures, were good, and even very good; four of the other crops have the large majority good or even very good; four have the majority bad, but the only crop which is bad throughout the whole of the thirty-four varieties of manuring is the ordinary red clover!

In another field, where an experiment on an ordinary four-course rotation of turnips, barley, red-clover, wheat, was commenced in 1848, and carried on, without any application of manure to the soil from that day to the season 1883, the following results were arrived at:

The third crop in the rotation was red-clover, and a very large produce was carried off, but, as usual, when the attempt was made to repeat the crop after an interval of four years, it failed. Beans were then tried in place of clover, and they were repeated every fourth year till 1873, when red-clover was sown with the barley. The crop was not diseased in any way, and it stood the winter, but there was no active growth; and the hay, which was cut three times, only weighed 1½ ton per acre. Beans were sown in the fourth following year, and red-clover was again tried with the barley in 1881; the crop, as on the previous occasion, stood the winter well, but the produce was very small, and would hardly bear the expense of cutting.

In another experiment, in the same field, where the turnips in the same rotation received a very liberal application of artificial manure every fourth year from the commencement, the clover was an exceedingly large crop. When this land was first put under experiment, in 1848, it was in rather high condition; the failure of the clover crop when repeated in the seventh year could not therefore be due to want of food in the soil, as in the interval between 1854 and 1874 the removal of twenty unmanured crops must have greatly impoverished the land, yet Lawes still obtained a crop, though a very small one; and even eight years later than that date the crop was not diseased.

Hence we draw the following extraordinary deductions:

The clover disease is not due to the poverty of the soil; and that it is not due to richness of soil is proved by the success of the clover crop when grown continuously on a rich garden soil.

And this disease of the clover plant is not a new thing by

(1) Of course, clover is neither artificial nor a grass, but the phrase is the ordinary one. A. R. J. F.