which is followed by bad crops of wheat.

Sir John Lawes, in a letter to the Country Gentleman, written in May, 1887, observes that considering the immense difference in the amount of fertility to be found in different soils, it is not strange that those who farm in the most favoured localities should be hard to convince that the disease really exists. They never saw its effects, therefore there is no such thing.

But any one who has ever watched the changes that have taken place in the 4-course rotation, as practised in the Eastern counties of England, and has, by asking questions, found that the failure of the clover-crop has been the sole cause of these changes, must be hard to convince if he does not believe in the existence of this mysterious disease.

When we were, in 1852, in the habit of visiting the markets of Essex, Hertfordshire, and Cambridgeshire, the constant subject of conversation among the farmers was the failure of the clover-crop, and the best possible substitute for that plant. The general opinion seemed to be that the red-clover should not be sown more frequently than once in twelve years, the 4-course rotation being extended to a 12-course rotation, as thus:

First round.—Roots, barley, clover, wheat;
Second round.—Roots, barley, trefoil, wheat;
Third round.—Roots, barley, pease, wheat.

The *trefoil* being the yellow or hop-clover - *medicago lupulina*—and the horse-bean, *faba vulgaris*, being sometimes, on heavy land, substituted for the pea. This change in the rotation turned out to be about the best that could be made, but, in spite of it, the wheat-crop in the second and third rounds was never so good as the wheat-crop in the first round.

Now we ask any unbiassed man: would the farmers of the above mentioned counties, men acknowledged to be the best farmers in England, have been likely to be so unwise as to give up the repetition of their best wheat producing crop, if the disease that prevented its growth was a mere matter of fancy?

The conclusion Sir John arrived at, after long and patiently conducted experiments on the failure of clover if too often repeated, was, in the first instance, that no combination of manures, natural or artificial, would cause land that was *clover-sick* to produce that crop. Of late years, however, the continuation of the Rothamsted experiments had taught Sir John, as he says, "two or three scraps of knowledge."

Red-clover had been grown continuously for 35 years on an old garden-soil without the application of any manure of any kind. Both soil and subsoil to the depth of 18 inches were very rich in nitrogen, it being evident that great quantities of dung had been trenched in to that depth. When Lawes wrote, the top-soil had lost a vast percentage of this nitrogen, but the land was still much richer than the farm-soil; the subsoil, even then, containing much more nitrogen than the topsoil of the farm-land. "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 are made into hay and carried off the land; and even when the clover-roots are, as far as possible picked out of the soil, we still find an increase of nitrogen to have taken place."

The crops of clover grown on this garden-piece were equal, if not superior, to the crops grown on the farm-land; but they were very inferior to those grown in the earlier periods of the experiment. The clover, at first, stood out for four or five years, but latterly had to be resown every other year. "We have evidence here that, while clover has been grown for 35 years in succession without any sign of disease, *it is hardly safe to repeat it on the farm unless at intervals of* 8 *or* 12 *years.*

A field at Rothamsted had been under experiment for nearly 40 years. Part of it had received no manure at all during that whole period. Another part had received mineral manure only—phosphoric acid and potash—while a third part had been very highly dressed with rape-cake, ammonia salts, *and* minerals Turnips were tried to be grown every fourth year; but whereas the minerals only gave 8 or 9 tons an acre, the highly manured land yielded about 20 tons On half of each plot, the turnips were carted off, and on the other half, they were chopped to pieces and ploughed in. The wheat, barley, and clover or beans which were grown during the other three years of the four rotation crops, were all carried off, straw and all

Nothing could be poorer, in organic matter and nitrogen, than the land from which the turnips and other crops were carried off, it having received only mineral manures. Where the turnips were ploughed in, the condition of the land would be a little better, and in the full-dressed portion the soil must have been full of fertility, particularly, again, where the turnips were interred

In 1874, and again in 1882, red-clover was grown over the whole of the experiment-land. Crops were large; on the highly manured land 4 tons of clover-hay each year; on the land manured with minerals only, 3 tons each year, and in the unmanured land, rather more that 1¼ *ton each year.* In 1885, red-clover was sown again, and lo! the disease made its appearance in 1886. As usual, the plant, that during the fall and winter had looked well, began to die off in patches in the spring. Sometimes, considerable strips were not attacked, and the hay was a fair crop, but, on the whole, about one-half was destroyed. On the two lands or ridges that had only received mineral manures and from which all the crops of the course had been carried off over since the experiment began (35 years). *there was no disease whatever!* Where the turnips had been ploughed in, there was some slight disease, though the crop was, in appearance, the more vigorous of the two: 2 tons 4 cwt., against 2 tons 2 cwt. an acre. Upon the unmanured portion there was nothing but plantain and coltsfoot, the clover seeming to have been starved out.

And, now, let us look at the two manured plots. The unmanured plot had been so completely exhausted, for all practical purposes, that it refused to grow either turnips or clover. Fancy the state of land after the entire removal of *thirty eight* crops in succession! Where the disease was absent, 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 was carried off in the crops.

But, where the disease committed the greatest ravages was on the portion that had received 2,000 lbs. of rape-cake, 200 lbs. of ammonium salts, and the mineral manure as well. besides the large crops (20 tons), of turnips having been ploughed in.

Did the immense amount of organic matter in this portion encourage the presence of an increased number of microbes, or other living organisms, that fed upon and thereby destroyed the clover plant? If this were so, why should the taking of a crop of beans or pease at the end of the fourth and eighth years, have rendered the growth of clover n the twelfth year free from the disease, at it probably from all practice would have been? Here, is the trouble. Can it be set at rest by concluding that the red clover requires, as part of its food, some special organic compound?

Again, here is a curious thing, deduced from the same course of experiments. No one ever heard of the *bean disease*—we speak, of course, of the horse-bean—; and yet, at Rothamsted, when beans were grown for a long series of years, in unmanured land, the crop degenerated so as at last to be only a few inches high. Was the plant-food exhausted on this plot? By no means, for although when the last miserable crop of beans was succeeded by barley sown down with clover, although the barley was "no great shakes," the clover-crop was magnificent! Now, after the last bean-crop, the soil was analysed, and found to have lost a large amount of organic nitrogen, and to be very poor in nitric acid. Remember, that beans and clover are both leguminous plants, and yet we have the fact that a soil that was becoming poorer in organic matter, nitrogen, phosphoric acid, and potash, ceased to furnish food for one leguminous plant, while it was preparing food for another plant of the same natural order. If the "magnificent" clover-crop was attributable to its imbibition of the free nitrogen of the air, why, the bean-plant has the same power as the clover; so we are as far off as ever from arriving at a solution of the puzzle.

The soil of the garden that grew clover for 35 successive years, had had no dressing of recent organic matter during all that period; so we may conclude that it afforded no food to the larger sorts of organic life in the soil, such as worms, &c., that might destroy the plant.

The conclusions Sir John Lawes draws from his experiments in connection with the "clover-desease," are the following:

"1. That this disease does not occur, even when the crop is grown continuously, provided that the soil contains in abundance the appropriate (*dominant*) food of the plant.

2. That the clover disease occurs in highly manured soils if the crop be repeated too frequently, and sufficient time is not followed for the formation of the appropriate food of clover.

3. That the fertility of a soil may be largely reduced by cropping, and by the absence of manure, while at the same time the food specially required by the clover may be increasing in the soil. The crops grown during the process of exhaustion may be, partly or wholly, plants of the same natural order as the clover, provided that they differ from the clover in certain properties of their growth and in the range of their roots.

4. That although clover does not appear to possess the same power of appropriating the mineral food of the soil as the cereal crops possess (for which reason mineral manures are often advantageously applied to this crop), still, mineral manures cannot be depended upon to grow clover on clover-sick land."

And now we turn to Dr Storer, another agricultural chemist, who says that clover-sickness is due to a want of *potash* in the soil. Those farmers, says he, that have applied kainit (Stassfurt potash) to land that was formerly clover sick, have succeeded in raising splendid crops of clover again. They have also found that *their clover is no longer thrown out* in the winter months, as was often the case before potash was used, and this *is doubtless* due to the increased *root* growth in the fall. So here we have two philosophers, Lawes and Storer, diametrically opposed to one another on a subject of vast importance. Lawes says: mineral manures, including potash, do not cure the clover-richness; Storer, on the other hand, says that the German farmers find that potash is a perfect remedy for that disease; only the latter does not say whether or no the German farmers, finding the clover-plant fail, allow a certain time to elapse before sowing it again.

Well, we presume that most readers of this excursus will be satisfied that there is such a thing as the clover-sickness, and that the most likely way to bring it on is the too frequent repetition of the crop on the same field. Therefore we say: sow clover: sow lots of clover; but be warned by the failure of this valuable plant in the hands of some of the best farmers in the world, and do not repeat the seeding more than once in eight years.

HEDGE-PLANTS.

WE are much interested in the introduction and growth of all useful and ornamental trees and shrubbery. Recently we spoke of the holly, desiring to know how far north it has been found growing. We now note the following in the Montreal *Journal of Agriculture*, with reference to the hardiness of the buckthorn as a hedge plant: "Buckthorn is also used in some localities, but it is doubtful if it is hardy enough to stand the cold of this Province; at least of the eastern and north-eastern part of it." As to the hardiness of buckthorn, we are pretty well prepared to testify, as we raised a lot of the plants from seed more than twenty-five years ago. We grew them in the nursery until about twenty inches high; then set a hedge of these over 700 feet long. It stood until three or fours years ago, when, although it was eight or ten feet high, thick and thorny, yet it was neither cattle nor thief proof; and as it occupied a strip ten feet wide, we uprooted it, and replaced it with an *eight-foot tight fence, which some of* our readers may have noticed as just completed three years ago, at the time the state muster was held in the adjoining field.

(*Watchman.*)

SEED GRAIN.

BY J. E. RICHARDSON, PRINCETON, ONT.

In a few months' time farmers will be commencing their spring work. Before spring opens up it would be well to take time to consider what different kinds of grain are to be sown. So much depends on the soil, that a farmer should be careful to sow grain that is adapted to his land. After deciding what kind of grain you intend sowing, say oats, peas, barley, the next question is, what variety of the above is best? This is a question which is very hard to answer. One thing is very important, and this is, whatever variety you select, try to get it pure and free from foul seeds. Many farm