ductive, as in the case of clover. Nevertheless, it is a fact that the larger the amount of mineral matter you remove in a crop of clover, and the larger the amount of nitrogen which is carried off in clover hay, the richer the land becomes. Now here is really a strange chemical anomaly which cannot be discarded, and invites our investigation; and it is an investigation which has occupied my attention, I may say for more than ten years. The explanation is very simple, though puzzling when you know not the chemical points that are involved in the investigation."

The Doctor then goes into some extensive calculations and analyses to prove his case, and continues:—

"We should, therefore, naturally expect that clover, which removes so much more nitrogen from the soil, would be greatly benefited by the application of nitrogenous manures; but the reverse is the case. Wheat, it is well known, is benefited by the application of nitrogenous matters, but not clover. On the other hand, clover is benefited by mineral manures, and at the same time it leaves the land even in a better condition in this respect for the succeeding grain crop than it is without the intervention of clover. I believe a vast amount of mineral manure is brought within reach of the grain crop by growing clover. It is rendered available to the roots of the grain crop, while otherwise it would remain in a locked up condition in the soil. Clover, by means of its long roots, penetrates a large mass of soil. It gathers up, so to speak, the phosphoric acid and the potash which are disseminated in the soil, and when the land is ploughed the roots are left in the surface, and in decaying they leave in an available condition the mineral substances which the wheat plant requires to enable it to grow. Although in clover hay these mineral matters are removed in great quantity, yet the store of mineral food that we have in six or twelve inches of soil is so great that the quantity removed is utterly insignificant in comparison with what remains.

"Some experiments bearing on this subject were tried by me at Leighton Buzzard, upon the farm of Mr. Robert Valentine. We had a capital field of clover, and I thought I should have a good opportunity of ascertaining whether there was more nitrogen accumulated in the soil after the clover crop was cut twice, or whether more was accumulated when the clover was mown once, and then allowed to run to seed. At first sight, you would think that the land was in a worse condition when the crop was grown for seed. We know, indeed, that this is generally the case, but in clover we have a remarkable exception to this rule; and I find, on looking into this matter, that, after growing clover for seed, a very much larger quantity of nitrogen remains in the surface soil, in the first six inches of soil as well as in the second six inches, than when the clover is mown twice. I have ascertained that when you feed off clover by sheep, when it is still young, and everything is returned to it as it is removed from it, the land is in a worse condition than when you take off the clover hay. This is an anomaly. You say it is against all principle and against all reason. But when you see positive evidence in our fields, I think no scientific man has a right to say that it is against all reason and against all principle. It is certainly not against fact. All who are practically acquainted with the subject must have seen that wheat invariably grows less luxuriantly when you feed the clover off quite young, and that the best crop of wheat is produced when you grow clover for seed. I have repeatedly and repeatedly seen it. Referring to those clover investigations, I would just give you the total amount of nitrogen which I found in different layers of soil in the same field, and upon one half of which the clover was mown twice, and upon the second half of which the clover was mown only once, and then left for seed. The percentage of nitrogen in the clover soil twice mowed, for the first six inches amounted to 168, in the second six inches to .092, and in the third six inches to .064. Thus you see that it becomes very much less the deeper you go down. The accumulation takes place chiefly in the surface soil, and I believe it is principally due to the dropping of the leaves. When we grow clover for seed, those leaves continually drop and enrich the surface soil; and if it be the case, which I think is likely, that the clover tribe of plants is satisfied with the ammonia which exists in the atmosphere, we can at once account for the accumulation of nitrogen in the soil. The clover plants take the nitrogen from the atmosphere, and manufacture it into their own substance, which, on decomposition of the clover roots and leaves, produces abundance of ammonia. In reality, the growing of clover is equivalent, to a great extent, to manuring with Peruvian guano; and there is a larger amount of nitrogen accumulated in the first six or twelve inches of soil than there is in the heaviest dose of Peruvian guano that any person would think of using.

"Thus, there is more certainty of growing a good crop of wheat through the instrumentality of clover than through the direct supply of nitrate of soda. These, then, are the chief points which have been established, I believe, by my chemical experiments in the laboratory with respect to the chemical history of the clover crop."

Rotary Engine for Farmers' Use.

There are, probably, many of our best farmers, who are quite unacquainted with the term, "rotary engine." Their ideas of a steam engine are principally formed from seeing the ordinary engine in use attached to locomotives, flouring mills, saw mills, and such like applications of the well known ordinary steam engine. But I have great faith in the recent invention of Messrs. Hamilton & Sons, of the St. Lawrence Foundry, Toronto, who, after two years trials, have produced the long desired "rotary engine." This consists of a revolving centre with wings attached, that close and open as it passes certain points within the outside casing. These wings are not a new invention, nor is the rotary motion a new invention. Probably thousands of trials have been made to produce an engine that would go continuously in a circular direction, instead of back and forth, as we see them ordinarily used, but hitherto without perfect success. The engines made would go round well enough, and had a certain amount of power, but there was always an unequal friction that wore some part away so fast, that the engine was virtually a failure, as regards any practical utility to be derived from the adaptation of the rotary instead of the crank motion, as ordinarily used.

The Messrs Hamilton have, it is hoped, quite overcome this difficulty. Their engines are so constructed that the pressure all round and on each side is equalized, thus reducing all wear in any one section of the machine, and causing the revolving centre to "float," as it were, in steam. The great benefit to be derived is extreme cheapness, as the cost will not exceed one-fourth that of an ordinary engine; great simplicity, as no skill is required to manage them. All that need be done is to open the communication with the boiler, and away goes the engine round and round, only requiring oiling, which any boy can apply, to prevent wear. The corner of any room will contain engine and boiler. A six-horse engine and boiler can be erected in a space of five by five feet, eight feet high, with outlet to the air for a chimney, about twice the size of an ordinary stove-pipe. The speed is another great advantage, as smaller pullies or drums will do the work, and lighter and narrower belts, these engines being calculated to run about two hundred revolutions in a minute, with perfect ease.

Farmers have long required such a machine. Nothing uses up horses faster than threshing machines, and the work they do is very small in comparison with a six or eight horse-power rotary steam engine, and the cost of feeding the horses is five times that of feeding the engine; moreover, the engine eats nothing when idle. The total weight of engine and boiler would not exceed an ordinary two-horse team load, and the moment the waggon stopped, on which the engine was loaded, the engine could be set to work. No staking down wanted, or making a track for the horses. Light the fire, and put on the steam, and the men who feed the machine will call out to stop long before the engine will be tired. The fuel consumed is very small. About one-third of a cord of common soft wood will run the engine twelve hours at full speed. Then, for sawing wood, nothing can be better adapted, or for any