LAWES ON AGRICULTURAL CHEMISTRY.

(Continued)

We shall see that, whereas Liebig's manure in spite of the surreptitious (1) introduction of a certain amount of ammoniacal material, it professing to be entirely composed of the constituents of the ashes of the plant proposed to be sown, had only the power to extract 3 bushels more wheat from an acre of land than was yielded by the continuously unmanured acre, 224 lbs. of sulphate of ammonia, (2) alone, caused a yield of about ten bushels more. Thus, in the harvest of 1846 we have the following selected results.—

Description and quantities of manure per acre.	Dressed grain per acre in bushels and pecks.		Total grain per acre in pounds.	Straw per acre.
Section 1.	bush.	pecks.	lbs.	lbs
Plot 3 No manure.....	17	3¾	1207	1513
Plot 2. 14 tons of farmyard dung	27	0¾	1826	2454
Section 2.				
Plot 10 b. No manure.....	17	2¼	1216	1455
Plot 10 a. Sulphate of ammonia 224 lbs...	27	1½	1850	2244
Section 3.				
Plot 5a1. Ash of 3 loads of wheat straw	19	0½		1541
Plot 5a2. Ash of 3 loads of wheat straw, and top dressed with 224 lbs. sulphate of ammonia	27	0		2309
Section 4.				
Plot 6a. Liebig's wheat manure 448 lbs....	20	1½	1400	1676
Plot 6b. Liebig's wheat manure 418 lbs. with 112 lbs. each of sulphate and muriate of ammonia.	29	0¾	1967	2571

In this table we see that the yields of the unmanured plots are so nearly alike that for all practical purposes they may be taken as equivalent; that the dressing of 14 tons per acre of farmyard dung raised the produce by nearly ten bushels an acre; that three loads of wheat straw burned increased the yield of the acre by the insignificant amount of one bushel, but that the addition of 224 lbs. of sulphate of ammonia to the ashes of the wheat straw added eight bushels to that yield; that 224 lbs. of sulphate of ammonia alone caused the crop to mount up to ten bushels more than the yield of the unmanured acre, and, lastly, that whereas Liebig's *patent* manure only gave an increased yield of 2 bushels and a peck more than the unmanured acre, the addition of 112 lb. each of muriate and sulphate of ammonia to the much vaunted manure caused an increase of almost 10 bushels an acre.

It is really very wonderful, when one comes to think of it, that Baron Liebig would not be convinced by these, to an unprejudiced eye, most satisfying experiments. He was too great a man to be suspected of wilful blindness, and as to interested motives, nobody could believe him to be actuated by them. However he was not satisfied, and he even went so far as to send his son over to England to see that the experiments were really such as they had been represented to be. I believe the great chemist died unrepentant, believing to his last hour that his mineral theory was the correct one.

In table V, which in rather too long and too intricate to give here, the experimenters compare the produce of the unmanured plot, with that of another which, except in the year 1844, when superphosphate of lime and silicate of potass were used (giving, however, less than one bushel of increase), was manured every season with ammoniacal manures alone. The average yields for the years from 1845 to 1850 of these plots unmanured, and manured with ammoniacal matters, were as follows:

Unmanured.	Bush.	pecks.	Straw.	Increase from manure. per acre. Bush.	pecks.	Straw.
Mean per annum.....	17	2¾	1756 lbs.			
Ammoniacal manures...						
Mean per annum	25	3¼	2698 lbs.	8	0½	933 lbs

Now let us look at another table, in which are displayed several varieties of manures applied together, and the yield compared with the unmanured crop. To show the idea Lawes and Gilbert wished to convey to the reader, I will quote an example of the mixed manures:

	lbs.
Pearl ash.....	300
Soda ash.....	200
Sulphate of magnesia ..	100
Bone ash	200
Sulphuric acid	150
Muriate of ammonia .	200
Sulphate of do ..	200

Yield per acre of unmanured plot, 15¼ bushels, yield of manured plot, 33⅓ bushels

In the same series of experiments, the amount of ammoniacal manures being reduced from 400 lbs. to 65 lbs the yield of the manured crop fell to 20 bushels per acre.

Well, I do not think I need bother you any further with the tables. We have seen enough to satisfy ourselves that the true manure for wheat must depend, for its value, on the quantity of its ammoniacal constituents There remain, then only a few observations.

From the unmanured plot were taken from the land *seven* successive crops of wheat, and this without any return of manure. Yet, no signs of diminished fertility appear, the average yield of the seven crops being 17½ bushels per acre, with about 1700 lbs. of straw, the crop depending upon the season: whether it was a good or bad 'wheat-year.' The difference which the season made was sometimes *very great, as, for instance, in the* year 1845, a good wheat-year all over England, the yield of the unmanured plot was 23¼ bushels, with 2712 lbs. of straw; the yield of the same in 1848 being only 14¾ bushels, with 1712 lbs. of straw, a difference of 8½ bushels of grain, and 1000 lbs. of straw, attributable solely to the variation in climateric influences. So we see clearly, that in land which has been properly cultivated for a number of centuries, I may say, like the soil of England, where grain and meat constitute almost the exclusive exports from the farm, the straw of the grain, and the dung of the animals fed upon the farm, finding their way back to the fields in the form of manure; we may see, I say, that even after seven successive crops of the same plant without any return, the soil still contained, relatively to the ammonia available from natural sources, an *excess* of the necessary mineral constituents.

But do not imagine for a moment that all soils, even in England, will go on producing 17½ bushels of wheat and 1700 lbs. of straw for ever. On the contrary, light soils which, under high farming, will yield great crops of grain in favourable seasons will soon fall off if neglected. As every Canadian farmer knows, heavy lands do possess a *native fertility*, or how can we account for the price at which land at St-Hugues sells as compared with the value of the land at Sorel, for instance? The one goes on yielding from 8 to 12 bushels of wheat per acre and other crops in proportion, and this without the sight of a dung-cart; the *other, treated in the same way for a* couple of years, would yield next to nothing, but well farmed and frequently though not copiously manured, will turn out most remunerative crops of anything you like to sow there. No; we cannot go on selling all our produce of the farm and making no return to it in manure; but what we can do is this: if there is any truth in the experiments we have been considering, we can feel safe in cultivating our farms in accordance with the ordinary methods of practical agriculture, and if at any time our crops in the spring show signs of a want of vegetative power, we know that a moderate top dressing of nitrogenous manures will enable them to start again into vigorous growth, and to utilise the *mineral* constituents which we are well assured will be, in such a case, in excess.

The following is the condensed history of one plot:

First year.—Mineral manures give one bushel more than the unmanured plot;

Second year.—Ammoniacal manures give 8¾ increase;

Third year.—After the heavy ammoniacal dressing of the previous year, and the heavy crop caused by it, the cessation of manuring reduces the produce to slightly *less* than the continuously unmanured plot;

Fourth year.—Ammoniacal salts alone increase the produce by one-half;

Fifth year.—A complex mineral manure, supplying nearly every mineral constituent in excess, and this combined with ammonia gives an average produce even rather less than was obtained in the previous year without the minerals, and the proportion of increase over the unmanured plot is very little greater.

When mineral manures are added to the ammoniacal dressings, as in *ordinary farming in England* is always done at least every fourth year in the usual farm-yard dung, we have added to the soil everything that plants can demand, but in the case we are considering it is worth while looking at the effects of this treatment with artificial manures. Thus, at Rothamstead the yield was:

	bush.	lbs. straw.
1845, sulphate and muriate of ammonia, 168 lbs. each.	31¾	4266
1845, sulphate and 112 lbs. each of ammonia *with minerals*.....	33	3819
1846, same ammoniacal dressing alone.....	27⅓	2244
1846, same ammoniacal *with minerals*	30½	2784
1847, with ammoniacal manure only	25⅔	2891
1847, *with ammoniacal and minerals*.....	32¼	3852
1848, was a failure altogether.....		
1849, with ammoniacal manure.....	32½	2854
1849, with ammoniacal manure and minerals...	33⅓	3858
1850, with ammoniacal manure.....	27	3089
1850, with ammoniacal manure and minerals...	29½	4034

Here we see that, although the plot in which ammoniacal manures alone are used, gives a considerably higher return than the unmanured plot, in every case in which *both* ammoniacal and mineral manures were employed, there was a considerably larger increase still.

The effect of mineral manures, then, for the growth of wheat is in these cases clearly shown; but what are the circumstances under which this result is obtained? It is only when after taking from the land the whole of the produce of a rotation without return, we provide *ammoniacal salts* alone, in such quantity as to yield crops year after year larger than the average obtained in the country in which the experiments were tried under the *ordinary course of rotation* treated with farmyard dung, and the produce obtained by these ammoniacal salts alone was very nearly equal to that obtained by the *annual* supply of 14 tons of the best manure, a dressing that nine

(1) I do not attribute the surreptitious introduction of the ammoniacal matter to the late Baron Liebig, but to the manufacturers of the *patent* manures

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(2) Containing about 45 lbs of nitrogen = 54.630 ammonia.