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Yields of the Field Experiments 1898

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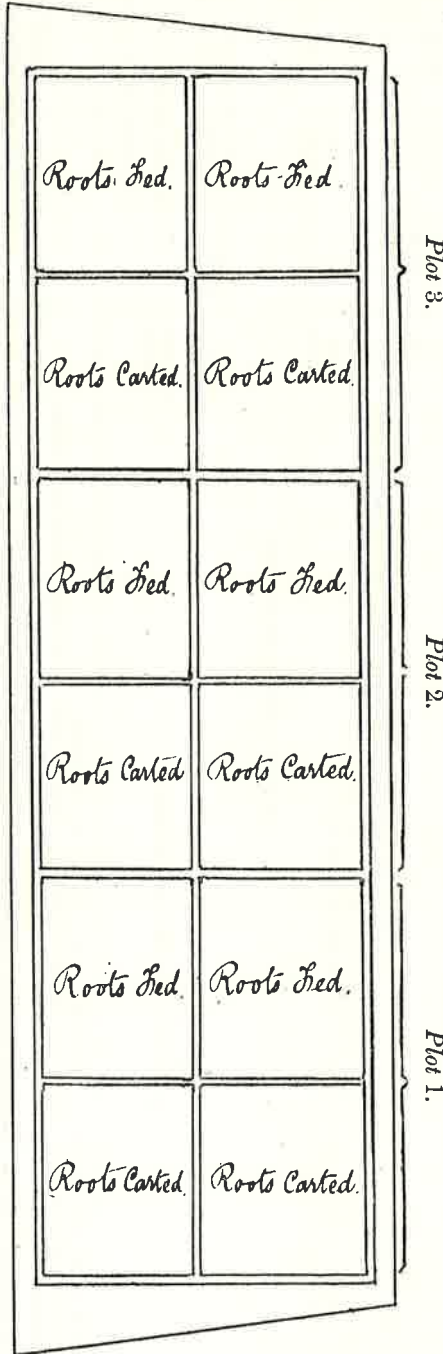
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PLAN OF THE PLOTS IN AGDELL FIELD,
ON WHICH EXPERIMENTS HAVE BEEN MADE
ON FOUR-COURSE ROTATION.

51 years, commencing 1848.

[For brief summary of results and conclusions, see opposite page.]



Total area of ploughed land about 3 acres.
Area of each of the 12 divisions $\frac{1}{2}$ acre.

- The 4 lower divisions, Unmanured continuously (Plot 1).
- The 4 middle divisions, Mineral Manure, for the Roots, each Course (Plot 2).
- The 4 upper divisions, Mineral and Nitrogenous Manure, for the Roots, each Course (Plot 3).
- The 6 left-hand divisions, Clover (or Beans), 3rd year each Course.
- The 6 right-hand divisions, Fallow, 3rd year each Course.

The double lines indicate division paths between plot and plot.

[For details of the manuring and produce, see pp. 100-109.]

RESULTS OF EXPERIMENTS MADE IN AGDELL FIELD, ON
THE ROTATION OF CROPS.

The experiments were commenced in 1848; so that 1898 is the 51st year of their continuance, and the third year of the 13th Course. In the experiments in other fields, some of the most important crops of rotation have been grown, each separately, for many years in succession—without manure, with farmyard manure, and with various artificial manures. But besides such experiments, others have been made on the growth of the crops in an actual course of rotation, without manure, and with different manures. The results with the individual crops throw much light on the characteristic requirements of each particular crop; whilst those on the growth of the crops in rotation serve to confirm and control those with the individual crops.

The rotation selected for investigation was the well known and typical four-course rotation of—1. Turnips; 2. Barley; 3. Leguminous Crops (or Fallow); 4. Wheat; that is, an alternation of Root-crops and of Leguminous Crops with cereals; which is the basis of most of the various rotations adopted in different parts of our own country, and also in many other countries. One portion of the land was left entirely without manure each course; another received mineral manure only, for the turnips of each course; and a third mixed mineral and nitrogenous manures, also only for the turnips of each course.

1. *The Swedish Turnips commencing each Course.*—When various root-crops were grown year after year on the same land without manure, they soon reverted to the uncultivated condition; and the experiments on rotation show that the Swedish turnips grown once in four years in unmanured rotation, came down to only about 1 ton per acre. The results further show, that mineral manures alone applied for the root-crops gave considerable increase, but that mineral and nitrogenous manures together gave more still. Without manure, the average produce of roots was less over the last 3 than over the preceding 8 courses; but with mineral manure alone (including potash in the last 3 courses) it was higher, and with mineral and nitrogenous manures together much higher, over the last 3 courses; the result being, however, largely due to more favourable seasons. Indeed, in 1888 and 1892, the years of root-crop in the 11th and 12th courses, although the produce without manure was less, that by each of the two descriptions of manure was considerably more than the average of the preceding courses; that is, both the reversion to the uncultivated condition without manure, and the increased growth with suitable manures, were very marked. In fact, without manure the produce of roots was as restricted in rotation as in continuous growth; with purely mineral manure it was greater in rotation than in continuous growth, the exhaustion of the available nitrogen of the soil being less under rotation; and with the mixed mineral and nitrogenous manure much more produce was obtained under rotation than with continuous growth. Lastly, the results conclusively show how artificial a product is the cultivated root-crop, and how dependent it is for its successful growth on an abundant supply of available food—nitrogenous as well as mineral—within the soil.

2. *The Barley Crops.*—Barley, without manure, succeeded the differently manured Swedish turnip crops of each course. Although the average produce of the root-crops was greater over the last 3 (10th, 11th, and 12th) than over the preceding 8 courses, the succeeding barley crops were much less over the last 3 courses. This was the case, not only where the root-crops had been carted off, but also where they had not been so removed. As, however, the produce of barley in the 3 years in question (1885, 1889, 1893) was also less than the average in Hoos Field where the crop is grown year after year, the result is doubtless mainly due to the seasons. Then, the average produce of barley over the 8 courses was actually less after the carted off roots grown by mineral manure (superphosphate) than after those grown without manure. The explanation is—that as there was practically no produce of roots without manure the unmanured plot was practically fallow for the barley; whilst with the mineral manure fair crops of roots were grown and removed, leaving the surface soil the more exhausted of its available nitrogen and other constituents. In the later years, however, after such long continued exhaustion, the unmanured plot has yielded less barley after the removal of the roots than the mineral manured plot. On the other hand, where the roots were not removed from the land, the mineral manured plot has generally yielded more barley than the unmanured. Further, under all conditions of treatment, the plots with mixed mineral and nitrogenous manure have yielded more barley than those with the mineral manure alone. In fact, the effects of the manurial and other treatment of the first crop of the course are clearly manifested in the produce of the second crop. Lastly, both without manure, and with the mineral manure alone, there was more produce of barley in rotation than in continuous growth, but with mixed mineral and nitrogenous manure there was more produce when the crop was grown continuously, the supply of nitrogen in that case being somewhat larger and annually applied for the crop.

3. *The Leguminous Crops (or Fallow).*—Under equal conditions as to manuring, the Leguminous crops, especially the clover, bring much more nitrogen into the course than either of the other crops. Further, the amount of nitrogen so brought into the rotation is much greater under the influence of mineral manures, and especially of potash manures, than without manure; whilst under the influence of the mixed mineral and nitrogenous manure the yield of nitrogen is greater still, the leguminous crop utilising the unexhausted nitrogenous manure- and crop-residue. For the successful growth of leguminous crops, however, a liberal supply of available mineral constituents within the soil, especially potash and lime, is essential. Judging from comparable cases, the amount of nitrogen accumulated by the Leguminous crops was much greater when they were grown in rotation, that is only occasionally, than when grown continuously. With fallow instead of a Leguminous crop, there is very much less nitrogen yielded in the rotation, and more liability to loss of it by drainage, and hence so much less brought into the circulation of the farm for food or manure. Lastly, most of the nitrogen of the leguminous crop is retained on the farm; and there is more or less, and sometimes much nitrogenous crop-residue left in the soil for succeeding crops.

4. *The Wheat Crops.*—There was very much more produce of wheat both without manure and with mineral manure, and considerably more with the mineral and nitrogenous manure, when it was grown in rotation than under comparable conditions continuously. Taking the quantities of produce by the mixed mineral and nitrogenous manure the result was that the two cereal crops produced approximately equal amounts of dry substance, and each considerably more than either of the assumed restorative crops—the roots or the leguminous crops. The supply of nitrogen within the soil available to the wheat crop is increased both by fallow and by the growth of a leguminous crop, especially of clover; and the accumulation is the greater when the soil and subsoil are not abnormally exhausted of organic nitrogen.

Upon the whole the results show that the benefits of rotation are very various. They depend on the varying requirements, habits of growth, and capabilities of gathering and assimilating the necessary constituents, of the different crops. The difference in the amounts available within the soil of the various mineral constituents, is one element in the explanation; but the facts relating to the amount, and to the sources, of the nitrogen of the different crops, are of still greater significance. The uses of the different crops have also to be taken into account. The cereals yield more produce for sale in the season of growth in rotation than when grown continuously. The crops alternated with them accumulate very much more of mineral constituents and of nitrogen in their produce; but by far the greater proportion of those constituents remains in circulation in the manure of the farm, whilst the remainder yields highly valuable products for sale in meat and milk. Again, with a variety of crops, the operations of the farm are better distributed over the year, and are therefore more economically performed. Lastly, the opportunities which alternate cropping afford for cleaning the land constitute a prominent element of advantage.

For details of the manuring and produce of the different plots, see pages 100–109.

AGDELL FIELD.
(Area under experiment, about 3 acres.)

EXPERIMENTS ON AN ACTUAL COURSE OF ROTATION—TURNIPS, BARLEY, LEGUMINOUS CROP (OR FALLOW), AND WHEAT.

These Experiments were commenced in 1848; so that the present season (1898) is the 51st, and the growing crop (Beans) is the third of the Thirteenth Course. One-third of the land has been continuously unmanured. One-third has, for the first Nine Courses, or 36 years, 1848-83, been manured with Superphosphate of Lime alone, once every four years, that is for the turnip-crop commencing each course; but for the Tenth, Eleventh, Twelfth, and Thirteenth Courses, a complex mineral manure has been applied, as described in foot-note, No. 2. Lastly, one-third has been manured (also for the turnip-crop only), with a complex mineral and Nitrogenous manure, as described in the foot-note No. 3. From half of each of the three differently manured plots the turnip-crops (roots and leaves) are removed; and on the other half they are either consumed on the land by sheep, or spread and ploughed in. In the case of all the other crops, the total produce is removed from the land.

TABLE I. (below), gives the results relating to the portions of each plot from which the turnip-crops were entirely removed; and on which clover or beans were grown.

Years.	Description of Crop.	PRODUCE PER ACRE.				Total Produce. (5)	Straw (or Leaf).	Corn (4) (or Roots).	Total Produce. (3)	Complex Mineral and Nitrogenous Manure, (2) for the Turnip Crops only.	Straw (or Leaf).	Corn (4) (or Roots).	Total Produce. (5)
		1 lb. (pound avoird.) per acre = (about) 1.12 Kilogramme per Hectare, or 0.57 Zollverein Pfund. per Prussian Morgen.	1 cwt. (hundredweight) per acre = (about) 125.5 Kilogrammes per Hectare, or 0.64 Centner per Pr. Morgen.	Plot 1. Unmanured continuously.	Plot 2. Superphosphate of Lime alone (1) Courses 1-9, Complex Mineral Manure (2) Courses 10-13, for the Turnip Crops only.								
1848	Norfolk White Turnips	65½ cwts.	1114 cwts.	225½ cwts.	332 cwts.	106½ cwts.	218 cwts.	332 cwts.	369½ cwts.	151½ cwts.	218 cwts.	369½ cwts.	
1849	Barley	44½ bush.	5656 lbs.	29½ bush.	3941 lbs.	2111 lbs.	28½ bush.	3941 lbs.	3794 lbs.	2088 lbs.	28½ bush.	3794 lbs.	
1850	Clover (calc'd. as hay) (6)	28½ bush.	5889 cwts.	28 bush.	564 cwts.	337½ lbs.	28½ bush.	564 cwts.	614 cwts.	3552 lbs.	28½ bush.	614 cwts.	
1851	Wheat.								5500 lbs.				
1852	Swedish Turnips.	26 cwts.	304 cwts.	223½ cwts.	2431 cwts.	904 cwts.	396½ cwts.	2431 cwts.	433 cwts.	364 cwts.	396½ cwts.	433 cwts.	
1853	Barley	34½ bush.	4464 lbs.	28½ bush.	3560 lbs.	1873 lbs.	364 bush.	3560 lbs.	4873 lbs.	2604 lbs.	364 bush.	4873 lbs.	
1854	Beans	5½ bush.	1445 lbs.	54 bush.	1584 lbs.	1109 lbs.	12½ bush.	1584 lbs.	2065 lbs.	1355 lbs.	12½ bush.	2065 lbs.	
1855	Wheat	35½ bush.	5859 lbs.	35½ bush.	5789 lbs.	3525 lbs.	37½ bush.	5789 lbs.	6371 lbs.	3942 lbs.	37½ bush.	6371 lbs.	
1856	Swedish Turnips.	32 cwts.	304 cwts.	136 cwts.	142½ cwts.	74 cwts.	533½ cwts.	142½ cwts.	346½ cwts.	124 cwts.	533½ cwts.	346½ cwts.	
1857	Barley	48½ bush.	5337 lbs.	28½ bush.	3976 lbs.	1475 lbs.	48 bush.	3976 lbs.	5163 lbs.	2435 lbs.	48 bush.	5163 lbs.	
1858	Beans	64 bush.	1615 lbs.	64 bush.	1605 lbs.	1155 lbs.	12½ bush.	1605 lbs.	2257 lbs.	1320 lbs.	12½ bush.	2257 lbs.	
1859	Wheat	35½ bush.	6262 lbs.	34½ bush.	6120 lbs.	3930 lbs.	38½ bush.	6120 lbs.	7154 lbs.	4610 lbs.	38½ bush.	7154 lbs.	
1860	Swedish Turnips.	1 cwt.	1 cwt.	29½ cwts.	30½ cwts.	1½ cwt.	87½ cwts.	30½ cwts.	90½ cwts.	54 cwts.	87½ cwts.	90½ cwts.	
1861	Barley	38½ bush.	4718 lbs.	30½ bush.	3775 lbs.	2000 lbs.	60½ bush.	3775 lbs.	7381 lbs.	3940 lbs.	60½ bush.	7381 lbs.	
1862	Beans	29 bush.	1689 lbs.	29½ bush.	4040 lbs.	2150 lbs.	48½ bush.	4040 lbs.	5390 lbs.	3280 lbs.	48½ bush.	5390 lbs.	
1863	Wheat	34½ bush.	5621 lbs.	34½ bush.	5619 lbs.	3390 lbs.	46½ bush.	5619 lbs.	7627 lbs.	4698 lbs.	46½ bush.	7627 lbs.	
1864	Swedish Turnips.	84 cwts.	94 cwts.	68 cwts.	72½ cwts.	44 cwts.	176½ cwts.	72½ cwts.	185 cwts.	84 cwts.	176½ cwts.	185 cwts.	
1865	Barley	39 bush.	4182 lbs.	33½ bush.	3394 lbs.	1615 lbs.	47½ bush.	3394 lbs.	5148 lbs.	2595 lbs.	47½ bush.	5148 lbs.	
1866	Beans	104 bush.	1689 lbs.	74 bush.	1463 lbs.	978 lbs.	204 bush.	1463 lbs.	3343 lbs.	1990 lbs.	204 bush.	3343 lbs.	
1867	Wheat	21 bush.	3473 lbs.	194 bush.	3222 lbs.	1966 lbs.	234 bush.	3222 lbs.	4567 lbs.	3003 lbs.	234 bush.	4567 lbs.	

6th Course, 1869-71.

1868	Swedish Turnips	Failed, and ploughed up.	Failed, and ploughed up.	Failed, and ploughed up.
1869	Barley	24½ bush.	28½ bush.	48½ bush.
1870	Beans	13½ bush.	15½ bush.	24½ bush.
1871	Wheat	20½ bush.	23½ bush.	34½ bush.
		1948 lbs.	3698 lbs.	5800 lbs.
		738 lbs.	768 lbs.	2664 lbs.
		189 lbs.	3048 lbs.	3440 lbs.
		492 lbs.		4942 lbs.

7th Course, 1872-75.

1872	Swedish Turnips	34½ cwts.	170½ cwts.	339½ cwts.
1873	Barley	23½ bush.	20½ bush.	31½ bush.
1874	Clover (calcd. as hay) (†)	4½ cwts.	17½ cwts.	35½ cwts.
1875	Wheat	21½ bush.	28½ bush.	31½ bush.
		1343 lbs.	1565 lbs.	1722 lbs.
		2430 lbs.	45½ cwts.	4685 lbs.
			5328 lbs.	6699 lbs.
				70½ cwts.
				375½ cwts.
				8373 lbs.

8th Course, 1876-79.

1876	Swedish Turnips	17½ cwts.	189½ cwts.	356 cwts.
1877	Barley	23½ bush.	24½ bush.	34½ bush.
1878	Beans	8½ bush.	7½ bush.	20½ bush.
1879	Wheat	10½ bush.	14½ bush.	13 bush.
		1291 lbs.	1045 lbs.	1655 lbs.
		740 lbs.	1771 lbs.	1658 lbs.
		1324 lbs.		2493 lbs.
				411½ cwts.
				3890 lbs.
				2963 lbs.
				2493 lbs.

9th Course, 1880-83.

1880	Swedish Turnips	14 cwts.	199½ cwts.	439½ cwts.
1881	Barley	26½ bush.	21½ bush.	2641 lbs.
1882	Clover (calcd. as hay) (†)	29½ bush.	36½ bush.	45½ bush.
1883	Wheat	2280 lbs.	4175 lbs.	5400 lbs.
		24 cwts.	11½ cwts.	43½ cwts.
		1484 lbs.	1259 lbs.	1853 lbs.
				43½ cwts.
				3857 lbs.
				794 cwts.
				6921 lbs.

10th Course, 1884-87.

1884	Swedish Turnips	5 cwts.	173½ cwts.	286½ cwts.
1885	Barley	12½ bush.	19½ bush.	34½ bush.
1886	Clover (weighed as hay) (†)	25½ bush.	42½ bush.	42½ bush.
1887	Wheat	1859 lbs.	3483 lbs.	5994 lbs.
		31 cwts.	204 cwts.	1934 cwts.
		1270 lbs.	1441 lbs.	2461 lbs.
				3423 lbs.
				250 cwts.
				426 lbs.
				29 cwts.
				6103 lbs.

11th Course, 1888-91.

1888	Swedish Turnips	4½ cwts.	207½ cwts.	473 cwts.
1889	Barley	9½ bush.	21½ bush.	26½ bush.
1890	Beans	7 bush.	24½ bush.	16½ bush.
1891	Wheat	29½ bush.	42½ bush.	44½ bush.
		17 cwts.	21½ cwts.	228½ cwts.
		931 lbs.	1221 lbs.	1653 lbs.
		603 lbs.	1764 lbs.	1102 lbs.
		2598 lbs.	3995 lbs.	4373 lbs.
				7250 lbs.
				45½ cwts.
				1653 lbs.
				2145 lbs.
				7250 lbs.

12th Course, 1892-95.

1892	Swedish Turnips	6½ cwts.	202½ cwts.	473 cwts.
1893	Barley	16½ bush.	15½ bush.	20½ bush.
1894	Clover (weighed as hay) (†)	23½ bush.	37 bush.	39 bush.
1895	Wheat	1713 lbs.	3267 lbs.	5034 lbs.
		0½ cwts.	8½ cwts.	206½ cwts.
		1440 lbs.	1339 lbs.	2295 lbs.
				5034 lbs.
				2683 lbs.
				485 cwts.
				2880 lbs.
				698 cwts.
				5126 lbs.

13th Course, 1896-99.

1896	Swedish Turnips	7½ cwts.	215½ cwts.	343½ cwts.
1897	Barley	11½ bush.	22½ bush.	30½ bush.
1898	Clover or Beans	1½ cwts.	144 cwts.	53½ cwts.
1899	Wheat	1251 lbs.	1790 lbs.	2328 lbs.
				397 cwts.
				4085 lbs.

(†) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1.7); Second Course—150 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate.
 (‡) For the Tenth Course, in addition to the Superphosphate for the Swedish Turnips—300 lbs. Sulphate of Potash, 200 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia were applied February 29, 1884, and harrowed in; and the same quantities were applied again before the final ploughing and preparation of the land for the sowing of the seed in May. For the Swedes of the Eleventh and Twelfth Courses the same mineral manures (which are the same as the mineral manures of Plot 3 for the third and subsequent Courses) were again applied, but only once for each of these two Courses. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, and 600 lbs. Basic Slag, per acre.
 (§) First Course—100 lbs. Pearl-ash, 100 lbs. Bone-ash, 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 1000 lbs. Rape-Cake; Second Course—300 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 100 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—300 lbs. Sulphate of Potash, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, per acre; Eleventh and Twelfth Courses—the same in other respects as in Courses 3-10, but the Superphosphate made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, 600 lbs. Basic Slag, 2000 lbs. Rape-cake, 100 lbs. Sulphate of Ammonia, and 100 lbs. Muriate of Ammonia, per acre.
 (¶) The quantities given in *Butcher's* represent the *Dressed* Corn only.
 (‡) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, Straw, and Chaff. (¶) Two cuttings.
 (§) Three cuttings.
 (¶) Three cuttings.

[For Summary Table of the above results, see pp. 108-9.]

A GDELL FIELD.
(Area under experiment, about 3 acres.)

EXPERIMENTS ON AN ACTUAL COURSE OF ROTATION—TURNIPS, BARLEY, LEGUMINOUS CROP (OR FALLOW), AND WHEAT.
These experiments were commenced in 1848; so that the present season, 1898, is the 51st, and the growing crop (beans) is the third of the Thirtieth Course.
One-third of the land has been continuously unmanured. One-third has, for the first Nine Courses, or 36 years, 1848-83, been manured with Superphosphate of Lime alone, once every four years, that is for the turnip-crop commencing each course; but for the Tenth, Eleventh, Twelfth, and Thirteenth Courses, a complex mineral manure has been applied, as described in foot-note, No. 2. Lastly, one-third has been manured (also for the turnip-crop only), with a complex mineral and Nitrogenous manure, as described in the foot-note, No. 3.
From half of each of the three differently manured plots, the turnip-crops (roots and leaves) are removed; and on the other half they are either consumed on the land by sheep, or spread and ploughed in. In the case of all the other crops, the total produce is removed from the land.

TABLE II. (below), gives the results relating to the portions of each plot from which the turnip-crops were entirely removed; and on which, in the third year of each course (excepting the first, 1850, when clover was grown), the land was left fallow.

Years.	Description of Crop.	PRODUCE PER ACRE.														
		Plot 1. Unmanured continuously.					Plot 2. Superphosphate of Lime alone (1), Courses 1-9, Complex Mineral Manure (2), Courses 10-13, for the Turnip Crops only.					Plot 3. Complex Mineral and Nitrogenous Manure (3), for the Turnip Crops only.				
		Corn (1) (or Roots).	Straw (or Leaf).	Total Produce (5)	Corn (1) (or Roots).	Straw (or Leaf).	Total Produce (5)	Corn (1) (or Roots).	Straw (or Leaf).	Total Produce (5)	Corn (1) (or Roots).	Straw (or Leaf).	Total Produce (5)			
		1st Course, 1848-51.														
1848	Swedish Turnips	175½ cwt.	19½ cwt.	195 cwt.	292 cwt.	35 cwt.	327 cwt.	384½ cwt.	46½ cwt.	441 cwt.						
1849	Barley	33½ bush.	2200 lbs.	4149 lbs.	29½ bush.	1870 lbs.	3875 lbs.	37 bush.	2342 lbs.	5026 lbs.						
1850	Clover (calcd as hay) (6)	..	..	57½ cwt.	..	..	604 cwt.	..	..	654 cwt.		
1851	Wheat	30½ bush.	3273 lbs.	5280 lbs.	31½ bush.	3497 lbs.	5617 lbs.	30½ bush.	3610 lbs.	5642 lbs.						
		2nd Course, 1852-55.														
1852	Swedish Turnips	37 cwt.	5½ cwt.	42½ cwt.	256½ cwt.	22½ cwt.	279½ cwt.	409½ cwt.	40 cwt.	448½ cwt.						
1853	Barley	324 bush.	2187 lbs.	4046 lbs.	32 bush.	2003 lbs.	3376 lbs.	37½ bush.	2595 lbs.	4349 lbs.						
1854	Fallow	..	..	..	..	..	..	..	..	..
1855	Wheat	37½ bush.	4295 lbs.	6735 lbs.	35½ bush.	4236 lbs.	6756 lbs.	38½ bush.	4952 lbs.	7428 lbs.						
		3rd Course, 1856-59.														
1856	Swedish Turnips	45½ cwt.	24 cwt.	474 cwt.	1704 cwt.	8 cwt.	176½ cwt.	328½ cwt.	114 cwt.	339½ cwt.						
1857	Barley	438 bush.	2330 lbs.	4777 lbs.	304 bush.	1545 lbs.	3272 lbs.	47½ bush.	2400 lbs.	5091 lbs.						
1858	Fallow	..	..	..	..	..	..	..	..	..
1859	Wheat	35½ bush.	4315 lbs.	6582 lbs.	37½ bush.	4310 lbs.	6671 lbs.	42½ bush.	5330 lbs.	8066 lbs.						
		4th Course, 1860-63.														
1860	Swedish Turnips	14 cwt.	04 cwt.	12 cwt.	323 cwt.	2 cwt.	35½ cwt.	87½ cwt.	34 cwt.	91 cwt.						
1861	Barley	35½ bush.	2190 lbs.	4248 lbs.	32½ bush.	1954 lbs.	3807 lbs.	60½ bush.	3920 lbs.	7419 lbs.						
1862	Fallow	..	..	..	..	..	..	..	..	..
1863	Wheat	45 bush.	4563 lbs.	7446 lbs.	46 bush.	4690 lbs.	7626 lbs.	52½ bush.	5495 lbs.	8537 lbs.						
		5th Course, 1864-67.														
1864	Swedish Turnips	74 cwt.	04 cwt.	84 cwt.	524 cwt.	44 cwt.	574 cwt.	1824 cwt.	9 cwt.	1914 cwt.						
1865	Barley	34½ bush.	1828 lbs.	3659 lbs.	314 bush.	1509 lbs.	3170 lbs.	44½ bush.	2398 lbs.	4799 lbs.						
1866	Fallow	..	..	..	..	..	..	..	..	..
1867	Wheat	27½ bush.	2694 lbs.	4330 lbs.	204 bush.	2774 lbs.	4420 lbs.	22½ bush.	2850 lbs.	4323 lbs.						

6th Course, 1868-71.

1868	Swedish Turnips	Failed, and ploughed up.	Failed, and ploughed up.	Failed, and ploughed up.
1869	Barley	21½ bush.	25½ bush.	39½ bush.
1870	Fallow	1628 lbs.	1873 lbs.	3064 lbs.
1871	Wheat	2075 lbs.	2128 lbs.	2628 lbs.
		3004 lbs.	3133 lbs.	3747 lbs.

7th Course, 1872-75.

1872	Swedish Turnips	60 cwts.	14½ cwts.	156½ cwts.
1873	Barley	2986 lbs.	1370 lbs.	31½ bush.
1874	Fallow	4412 lbs.	3230 lbs.	3623 lbs.
1875	Wheat	2833 lbs.	29½ bush.	3623 lbs.
		4412 lbs.	5065 lbs.	5443 lbs.

8th Course, 1876-79.

1876	Swedish Turnips	31½ cwts.	17 cwts.	308½ cwts.
1877	Barley	23 bush.	1084 lbs.	1625 lbs.
1878	Fallow	1244 lbs.	1956 lbs.	2905 lbs.
1879	Wheat	1493 lbs.	14½ bush.	12½ bush.
		2162 lbs.	2905 lbs.	1691 lbs.

9th Course, 1880-83.

1880	Swedish Turnips	32½ cwts.	12½ cwts.	450½ cwts.
1881	Barley	29½ bush.	1239 lbs.	37 bush.
1882	Fallow	1556 lbs.	3686 lbs.	3689 lbs.
1883	Wheat	33½ bush.	6208 lbs.	6132 lbs.
		5140 lbs.	6208 lbs.	3689 lbs.

10th Course, 1884-87.

1884	Swedish Turnips	17½ cwts.	18½ cwts.	288½ cwts.
1885	Barley	15½ bush.	1043 lbs.	19 bush.
1886	Fallow	2505 lbs.	3465 lbs.	1523 lbs.
1887	Wheat	34½ bush.	6103 lbs.	39½ bush.
		4639 lbs.	6103 lbs.	3308 lbs.

11th Course, 1888-91.

1888	Swedish Turnips	15 cwts.	15½ cwts.	431½ cwts.
1889	Barley	15½ bush.	965 lbs.	20 bush.
1890	Fallow	953 lbs.	1775 lbs.	1231 lbs.
1891	Wheat	32 bush.	3586 lbs.	41 bush.
		2941 lbs.	5742 lbs.	4238 lbs.

12th Course, 1892-95.

1892	Swedish Turnips	9½ cwts.	4½ cwts.	523½ cwts.
1893	Barley	19½ bush.	1203 lbs.	18½ bush.
1894	Fallow	1614 lbs.	2188 lbs.	1597 lbs.
1895	Wheat	21½ bush.	4011 lbs.	32½ bush.
		3066 lbs.	4011 lbs.	2368 lbs.

13th Course, 1896-99.

1896	Swedish Turnips	16½ cwts.	8½ cwts.	345 cwts.
1897	Barley	11½ bush.	969 lbs.	21½ bush.
1898	Fallow	9¼ lbs.	1699 lbs.	1677 lbs.
1899	Wheat	11½ bush.	85 cwts.	380 cwts.
		1609 lbs.	1465 lbs.	2639 lbs.

(1) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1.7); Second Course—100 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twentieth Courses—made from high percentage mineral phosphates, and containing 37 per cent. or more of soluble phosphates.
 (2) For the Tenth Course, in addition to the Superphosphate for the Swedish Turnips—300 lbs. Sulphate Potash, 200 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia, were applied February 23, 1884, and harrowed in; and the same quantities were applied again before the first ploughing and preparation of the land for the sowing of the seed in May. For the Swedes of the Eleventh and Twelfth Courses the same mineral manures (which are the same as the mineral manures of Plot 3 for the Third and subsequent Courses) were again applied, but only once for each of these two Courses. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, and 600 lbs. Basic Slag, per acre.
 (3) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 1000 lbs. Rape-cake; Second Course—300 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 160 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, Tenth Courses—300 lbs. Sulphate of Potash, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 2000 lbs. Rape-cake, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, per acre; Eleventh and Twelfth Courses—the same in other respects as in Courses 3-10, but the Superphosphate made from high percentage mineral phosphates, and containing 37 per cent. or more, of soluble phosphates. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, 600 lbs. Basic Slag, 2000 lbs. Rape-cake, 100 lbs. Sulphate of Ammonia, and 100 lbs. Muriate of Ammonia, per acre.
 (4) The quantities given in *Bushels* represent the *Dressed* Corn only.
 (5) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, Straw, and Chaff.
 (6) Two cuttings.

[For Summary Table of the above results, see pp. 108-9.]

A GDELL FIELD.

(Area under experiment, about 3 acres.)

EXPERIMENTS ON AN ACTUAL COURSE OF ROTATION—TURNIPS, BARLEY, LEGUMINOUS CROP (OR FALLOW), AND WHEAT.

These experiments were commenced in 1848; so that the present season, 1898, is the 51st, and the growing crop (Beans) is the third of the Thirteenth Course. One-third of the land has been continuously unmanured. One-third has, for the first Nine Courses, or 36 years, 1848-83, been manured with Superphosphate of Lime alone, once every four years, that is, for the turnip-crop commencing each course; but for the Tenth, Eleventh, Twelfth, and Thirteenth Courses, a complex mineral manure has been applied, as described in foot-note, No. 2. Lastly, one-third has been manured (also for the turnip-crop only), with a complex mineral and Nitrogenous manure, as described in the foot-note, No. 3. From half of each of the three differently manured plots, the turnip-crops (roots and leaves) are removed; and on the other half they are either consumed on the land by sheep, or spread and ploughed in. In the case of all the other crops, the total produce is removed from the land.

TABLE III. (below), gives the results relating to the portions of each plot on which the turnip-crops were either fed off by sheep, or cut and spread on the land; and on which clover or beans were grown.

Years.	Description of Crop.	Plot 1. Unmanured continuously.					Plot 2. Superphosphate of Lime alone(1), Courses 1-9, Complex Mineral Manure(2), Courses 10-13, for the Turnip Crops only.					Plot 3. Complex Mineral and Nitrogenous Manure(3), for the Turnip Crops only.													
		1st Course, 1848-51.		2nd Course, 1852-55.		3rd Course, 1856-59.		4th Course, 1860-63.		5th Course, 1864-67.		1st Course, 1848-51.		2nd Course, 1852-55.		3rd Course, 1856-59.		4th Course, 1860-63.		5th Course, 1864-67.					
		Corn (1) (or Roots).	Straw (or Leaf).	Total Produce (3).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce (5).			
1848	Norfolk White Turnips	109 cwt.	673 cwt.	1764 cwt.	2204 cwt.	90 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.	229 cwt.	3104 cwt.		
1849	Barley	48 bush.	3225 lbs.	6046 lbs.	424 bush.	3327 lbs.	90 cwt.	5885 lbs.	424 bush.	3327 lbs.	90 cwt.	5885 lbs.	424 bush.	3327 lbs.	90 cwt.	5885 lbs.	424 bush.	3327 lbs.	90 cwt.	5885 lbs.	424 bush.	3327 lbs.	90 cwt.	5885 lbs.	
1850	Clover (called as hay) (6)	304 bush.	3760 lbs.	5556 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	32 bush.	4014 lbs.	
1851	Wheat	19 1/2 cwt.	2077 lbs.	3317 lbs.	2504 cwt.	22 cwt.	2724 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.
1852	Swedish Turnips	23 1/2 bush.	953 lbs.	1367 lbs.	38 bush.	104 bush.	144 cwt.	404 cwt.	38 bush.	104 bush.	144 cwt.	404 cwt.	38 bush.	104 bush.	144 cwt.	404 cwt.	38 bush.	104 bush.	144 cwt.	404 cwt.	38 bush.	104 bush.	144 cwt.	404 cwt.	
1853	Barley	7 bush.	3351 lbs.	5226 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	
1854	Beans	34 1/2 bush.	3351 lbs.	5226 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	36 1/2 bush.	3611 lbs.	
1855	Wheat	204 cwt.	2312 lbs.	3546 lbs.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	
1856	Swedish Turnips	40 1/2 bush.	965 lbs.	1307 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	52 1/2 bush.	3745 lbs.	
1857	Barley	57 bush.	3355 lbs.	5265 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	
1858	Beans	30 1/2 bush.	3355 lbs.	5265 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	37 1/2 bush.	3745 lbs.	
1859	Wheat	204 cwt.	2312 lbs.	3546 lbs.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	196 cwt.	2104 cwt.	
1860	Swedish Turnips	1 cwt.	1970 lbs.	2961 lbs.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	
1861	Barley	29 1/2 bush.	1845 lbs.	2635 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	
1862	Beans	27 bush.	1845 lbs.	2635 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	30 bush.	3546 lbs.	
1863	Wheat	30 1/2 bush.	3008 lbs.	4941 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	
1864	Swedish Turnips	1 cwt.	1970 lbs.	2961 lbs.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	38 1/2 bush.	104 bush.	144 cwt.	404 cwt.	
1865	Barley	27 1/2 bush.	1460 lbs.	2244 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	41 1/2 bush.	3888 lbs.	
1866	Beans	84 bush.	905 lbs.	1435 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	10 bush.	2506 lbs.	
1867	Wheat	15 1/2 bush.	1524 lbs.	2506 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	25 bush.	2648 lbs.	

6th Course, 1868-71.

1868	Swedish Turnips	Failed, and ploughed up.	Failed, and ploughed up.	Failed, and ploughed up.
1869	Barley	25½ bush.	384 bush.	42½ bush.
1870	Beans	17½ bush.	878 lbs.	1008 lbs.
1871	Wheat	21½ bush.	2980 lbs.	3644 lbs.

7th Course, 1872-75.

1872	Swedish Turnips	7½ cwts.	19½ cwts.	39 cwts.
1873	Barley	1495 lbs.	1841 lbs.	2456 lbs.
1874	Clover (alc ^d as hay) ⁽⁷⁾	22½ cwts.	3575 lbs.	45½ bush.
1875	Wheat	2353 lbs.	3928 lbs.	4385 lbs.

8th Course, 1876-79.

1876	Swedish Turnips	21 cwts.	25½ cwts.	63 cwts.
1877	Barley	23½ bush.	1894 lbs.	49½ bush.
1878	Beans	7½ bush.	4157 lbs.	1880 lbs.
1879	Wheat	8½ bush.	2241 lbs.	26½ bush.

9th Course, 1880-83.

1880	Swedish Turnips	21 cwts.	224½ cwts.	38½ cwts.
1881	Barley	1468 lbs.	3951 lbs.	3078 lbs.
1882	Clover (alc ^d as hay) ⁽⁶⁾	22½ cwts.	704 cwts.	4505 lbs.
1883	Wheat	2060 lbs.	5901 lbs.	7743 lbs.

10th Course, 1884-87.

1884	Swedish Turnips	12 cwts.	229 cwts.	63½ cwts.
1885	Barley	1379 lbs.	4193 lbs.	5946 lbs.
1886	Clover (weight ^d as hay) ⁽⁶⁾	11½ cwts.	42 cwts.	52½ cwts.
1887	Wheat	1844 lbs.	6332 lbs.	6409 lbs.

11th Course, 1888-91.

1888	Swedish Turnips	8 cwts.	272½ cwts.	40½ cwts.
1889	Barley	865 lbs.	3250 lbs.	2030 lbs.
1890	Beans	81 bush.	1630 lbs.	25½ bush.
1891	Wheat	26½ bush.	3269 lbs.	1059 lbs.

12th Course, 1892-95.

1892	Swedish Turnips	6½ cwts.	254½ cwts.	333½ cwts.
1893	Barley	144 bush.	1466 lbs.	25½ bush.
1894	Clover (weight ^d as hay) ⁽⁶⁾	17½ cwts.	644 cwts.	83½ cwts.
1895	Wheat	1619 lbs.	5325 lbs.	5292 lbs.

13th Course, 1896-99.

1896	Swedish Turnips	11½ cwts.	240½ cwts.	61½ cwts.
1897	Barley	986 lbs.	4919 lbs.	3353 lbs.
1898	Clover or Beans	11½ bush.	37½ bush.	42½ bush.
1899	Wheat	114 bush.	2794 lbs.	380½ cwts.

(1) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1.7); Second Course—160 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—200 lbs. Bone-ash, and 150 lbs. Sulphuric Acid, *per acre*; Eleventh and Twelfth Courses—made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate.

(2) For the Tenth Course, in addition to the Superphosphate for the Swedish Turnips—300 lbs. Sulphate of Potash, 200 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia were applied February 29, 1884, and harrowed in; and the same quantities were applied again before the final ploughing and preparation of the land for the sowing of the seed in May. For the Swedes of the Eleventh and Twelfth Courses the same mineral manures (which are the same as the mineral manures of Plot 3 for the Third and subsequent Courses) were again applied, but only once for each of these two Courses. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, and 600 lbs. Basic Slag, *per acre*.

(3) First Course—100 lbs. Pearl-ash, 100 lbs. Bone-ash, 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Marinate of Ammonia, and 1000 lbs. Rape-cake; Second Course—300 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 160 lbs. Bone-ash, 200 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Marinate of Ammonia, and 500 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—300 lbs. Sulphate of Potash, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Marinate of Ammonia, and 2000 lbs. Rape-cake, *per acre*; Eleventh and Twelfth Courses—the same in other respects as in Courses 3-10, but the Superphosphate made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, 600 lbs. Basic Slag, 2000 lbs. Rape-cake, 100 lbs. Sulphate of Ammonia, and 100 lbs. Marinate of Ammonia, *per acre*.

(4) The quantities given in *Swedes* represent the *Dressed Corn* only.

(5) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, Straw, and Chaff.

(6) Two cuttings.

(7) Three cuttings.

[For Summary Table of the above results, see pp. 108-9.]

AGDELL FIELD.

(Area under experiment, about 3 acres.)

EXPERIMENTS ON AN ACTUAL COURSE OF ROTATION—TURNIPS, BARLEY, LEGUMINOUS CROP (OR FALLOW), AND WHEAT.

These Experiments were commenced in 1848; so that the present season, 1898, is the 51st, and the growing crop (Beans) is the third of the Thirteenth Course. One-third has, for the first Nine Courses, or 36 years, 1848-83, been manured with Superphosphate of Lime alone, once every four years, that is for the turnip-crop commencing each course; but for the Tenth, Eleventh, Twelfth, and Thirteenth Courses, a complex mineral manure has been applied, as described in foot-note, No. 2. Lastly, one-third has been manured (also for the turnip-crop only), with a complex mineral and Nitrogenous manure, as described in the foot-note, No. 3. From half of each of the three differently manured plots, the turnip-crops (roots and leaves) are removed; and on the other half they are either consumed on the land by sheep, or spread and ploughed in. In the case of all the other crops, the total produce is removed from the land.

TABLE IV. (below), gives the results relating to the portions of each plot on which the turnip-crops were either fed off by sheep, or cut and spread on the land; and on which, in the third year of each course (excepting the first, 1850, when clover was grown), the land was left fallow.

Years.	Description of Crop.	PRODUCE PER ACRE.														
		Plot 1. Unmanured continuously.					Plot 2. Superphosphate of Lime alone. (1) Courses 1-9, Complex Mineral Manures (2) Courses 10-13; for the Turnip Crops only.					Plot 3. Complex Mineral and Nitrogenous Manure, (3) for the Turnip Crops only.				
		Corn (1) (or Roots).	Straw (or Leaf).	Total Produce. (2)	Corn (4) (or Roots).	Straw (or Leaf).	Total Produce. (3)	Corn (5) (or Roots).	Straw (or Leaf).	Total Produce. (4)	Corn (6) (or Roots).	Straw (or Leaf).	Total Produce. (5)			
1 lb. (pound avoird.) per acre = (about) 1.12 Kilogramme per Hectare, or 0.57 Zollverein Pfund, per Prussian Morgen. 1 cwt. (hundredweight) per acre = (about) 125.5 Kilogrammes per Hectare, or 0.64 Centner per Pr. Morgen.																
1st Course, 1848-51.																
1848	Swedish Turnips	17 1/2 cwt.	20 1/2 cwt.	193 1/2 cwt.	34 1/2 cwt.	39 1/2 cwt.	384 1/2 cwt.	429 cwt.	463 cwt.	475 1/2 cwt.	429 cwt.	463 cwt.				
1849	Barley	44 1/2 bush.	3139 lbs.	5755 lb.	41 bush.	3209 lbs.	6704 lb.	444 bush.	3709 lbs.	6344 lb.	444 bush.	3709 lbs.				
1850	Clover (calcd as hay) (6)			62 1/2 cwt.			60 1/2 cwt.			65 cwt.						
1851	Wheat	31 1/2 bush.	3498 lbs.	5584 lb.	32 1/2 bush.	3534 lbs.	6062 lb.	27 1/2 bush.	3969 lbs.	5801 lb.	27 1/2 bush.	3969 lbs.				
2d Course, 1852-55.																
1852	Swedish Turnips	27 1/2 cwt.	4 cwt.	31 1/2 cwt.	27 1/2 cwt.	22 1/2 cwt.	295 1/2 cwt.	390 1/2 cwt.	37 1/2 cwt.	428 1/2 cwt.	390 1/2 cwt.	37 1/2 cwt.				
1853	Barley	33 bush.	2210 lbs.	4161 lb.	39 1/2 bush.	2739 lbs.	5110 lb.	37 1/2 bush.	3323 lbs.	5672 lb.	37 1/2 bush.	3323 lbs.				
1854	Fallow															
1855	Wheat	37 1/2 bush.	4070 lbs.	6473 lb.	37 1/2 bush.	4492 lbs.	6961 lb.	37 1/2 bush.	5107 lbs.	7499 lb.	37 1/2 bush.	5107 lbs.				
3rd Course, 1856-59.																
1856	Swedish Turnips	34 cwt.	2 cwt.	36 cwt.	193 1/2 cwt.	12 1/2 cwt.	206 cwt.	332 1/2 cwt.	12 1/2 cwt.	351 1/2 cwt.	332 1/2 cwt.	12 1/2 cwt.				
1857	Barley	44 1/2 bush.	2430 lbs.	4912 lb.	48 1/2 bush.	2585 lbs.	5326 lb.	66 1/2 bush.	3570 lbs.	7261 lb.	66 1/2 bush.	3570 lbs.				
1858	Fallow															
1859	Wheat	35 1/2 bush.	4045 lbs.	6270 lb.	39 1/2 bush.	4720 lbs.	7242 lb.	40 1/2 bush.	5545 lbs.	8136 lb.	40 1/2 bush.	5545 lbs.				
4th Course, 1860-63.																
1860	Swedish Turnips	1 1/2 cwt.	1 cwt.	1 1/2 cwt.	40 1/2 cwt.	2 cwt.	42 1/2 cwt.	87 cwt.	5 1/2 cwt.	92 1/2 cwt.	87 cwt.	5 1/2 cwt.				
1861	Barley	33 bush.	2018 lbs.	3871 lb.	40 1/2 bush.	2415 lbs.	4803 lb.	57 1/2 bush.	4175 lbs.	7654 lb.	57 1/2 bush.	4175 lbs.				
1862	Fallow															
1863	Wheat	42 bush.	4295 lbs.	6909 lb.	49 1/2 bush.	5051 lbs.	8194 lb.	49 bush.	5638 lbs.	8747 lb.	49 bush.	5638 lbs.				
5th Course, 1864-67.																
1864	Swedish Turnips	9 cwt.	3 cwt.	9 1/2 cwt.	79 1/2 cwt.	5 1/2 cwt.	84 1/2 cwt.	185 1/2 cwt.	9 1/2 cwt.	195 cwt.	185 1/2 cwt.	9 1/2 cwt.				
1865	Barley	35 1/2 bush.	1809 lbs.	3695 lb.	39 1/2 bush.	2043 lbs.	4122 lb.	46 1/2 bush.	3274 lbs.	5753 lb.	46 1/2 bush.	3274 lbs.				
1866	Fallow															
1867	Wheat	23 1/2 bush.	2538 lbs.	4126 lb.	27 1/2 bush.	2989 lbs.	4702 lb.	19 1/2 bush.	2905 lbs.	4180 lb.	19 1/2 bush.	2905 lbs.				

6th Course, 1868-71.

1868	Swedish Turnips	Failed and ploughed up.	Failed and ploughed up.	Failed and ploughed up.
1869	Barley	21 bush.	30½ bush.	38½ bush.
1870	Fallow	1643 lbs.	2343 lbs.	3244 lbs.
1871	Wheat	14½ bush.	15½ bush.	17½ bush.
		1946 lbs.	2340 lbs.	2863 lbs.
				3925 lbs.

7th Course, 1872-75.

1872	Swedish Turnips	49½ cwts.	167½ cwts.	331½ cwts.
1873	Barley	20½ bush.	27 bush.	47 bush.
1874	Fallow	1311 lbs.	1611 lbs.	184½ cwts.
1875	Wheat	24½ bush.	3525 lbs.	5443 lbs.
		4396 lbs.		
				4085 lbs.
				5942 lbs.

8th Course, 1876-79.

1876	Swedish Turnips	32½ cwts.	208½ cwts.	377½ cwts.
1877	Barley	22½ bush.	31½ bush.	44½ bush.
1878	Fallow	1275 lbs.	1706 lbs.	224½ cwts.
1879	Wheat	11½ bush.	1343 lbs.	1843 lbs.
		2351 lbs.		2755 lbs.
				1426 lbs.
				2100 lbs.

9th Course, 1880-83.

1880	Swedish Turnips	33½ cwts.	238½ cwts.	447½ cwts.
1881	Barley	31½ bush.	28½ bush.	47½ bush.
1882	Fallow	1565 lbs.	1900 lbs.	251½ cwts.
1883	Wheat	32½ bush.	4110 lbs.	6773 lbs.
		3231 lbs.		
				38 cwts.
				2993 lbs.
				4023 lbs.
				6536 lbs.

10th Course, 1884-87.

1884	Swedish Turnips	20½ cwts.	172½ cwts.	298½ cwts.
1885	Barley	22½ bush.	17½ bush.	32½ bush.
1886	Fallow	1768 lbs.	1430 lbs.	191½ cwts.
1887	Wheat	33½ bush.	3480 lbs.	6105 lbs.
		2655 lbs.		
				66½ cwts.
				2773 lbs.
				3763 lbs.
				6410 lbs.

11th Course, 1888-91.

1888	Swedish Turnips	23 cwts.	166 cwts.	423½ cwts.
1889	Barley	16½ bush.	19½ bush.	23½ bush.
1890	Fallow	996 lbs.	1135 lbs.	182 cwts.
1891	Wheat	31½ bush.	4103 lbs.	6509 lbs.
		2898 lbs.		
				35 cwts.
				1776 lbs.
				4938 lbs.
				7610 lbs.

12th Course, 1892-95.

1892	Swedish Turnips	12½ cwts.	269½ cwts.	500½ cwts.
1893	Barley	19 bush.	15½ bush.	25½ bush.
1894	Fallow	1639 lbs.	1245 lbs.	267½ cwts.
1895	Wheat	22½ bush.	2403 lbs.	4423 lbs.
		1728 lbs.		
				11½ cwts.
				1979 lbs.
				2575 lbs.
				4651 lbs.

13th Course, 1896-99.

1896	Swedish Turnips	24½ cwts.	177½ cwts.	331½ cwts.
1897	Barley	13½ bush.	19½ bush.	35½ bush.
1898	Fallow	1153 lbs.	1425 lbs.	188½ cwts.
1899	Wheat	4 cwts.	11½ cwts.	188½ cwts.
				2530 lbs.
				48 cwts.
				2570 lbs.
				4551 lbs.

(1) First Course—100 lbs. Bone-ash, and 100 lbs. Sulphuric Acid (sp. gr. 1.7); Second Course—150 lbs. Bone-ash, 120 lbs. Sulphuric Acid; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—200 lbs. Bone-ash, and 100 lbs. Sulphuric Acid; Eleventh and Twelfth Courses—made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate.

(2) For the Tenth Course, in addition to the Superphosphate for the Swedish Turnips—300 lbs. Sulphate of Potash, 200 lbs. Sulphate of Soda, and 100 lbs. Sulphate of Magnesia were applied February 29, 1884, and narrowed in; and the same quantities were applied again before the final ploughing and preparation of the land for the sowing of the seed in May. For the Swedes of the Eleventh and Twelfth Courses the same mineral manures (which are the same as the mineral manures of Plot 3 for the Third and subsequent Courses) were again applied, but only once for each of these two Courses. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, and 500 lbs. Basic Slag, per acre.

(3) First Course—100 lbs. Bone-ash, 100 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 1000 lbs. Rape-cake; Second Course—300 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 100 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, Seventh, Eighth, Ninth, and Tenth Courses—300 lbs. Sulphate of Potash, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, per acre; Eleventh and Twelfth Courses—the same in other respects as in Courses 3-10, but the Superphosphate made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate. For the Swedes of the Thirteenth Course—500 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 200 lbs. Sulphate of Magnesia, 500 lbs. Basic Slag, 2000 lbs. Rape-cake, 100 lbs. Sulphate of Ammonia, and 100 lbs. Muriate of Ammonia, per acre.

(4) The quantities given in *Bioscience* represent the *Dressed Corn* only.

(5) The "Total Produce" of the Corn-crops includes Dressed Corn, Offal Corn, Straw, and Chaff.

(6) Two cuttings.

[For Summary Table of the above results, see pp. 108-9.]

AGDELL FIELD.

(Area under experiment, about 3 acres.)

EXPERIMENTS ON AN ACTUAL COURSE OF ROTATION—TURNIPS, BARLEY, LEGUMINOUS CROP (OR FALLOW), AND WHEAT.

SUMMARIES OF THE RESULTS GIVEN IN TABLES I, II, III, AND IV. (pp. 100-1, 102-3, 104-5, and 106-7), RESPECTIVELY.

As the Table shows, averages are given for each of the four portions of the experimental land, for which Tables I, II, III, and IV, respectively, give the details. The averages are given, first of the produce of the eight intermediate Courses (Courses 2-9, 1852-1883); that is, excluding the First Course, when the land was in somewhat uneven condition, and when (as the detailed Tables show), on some portions Norfolk Whites, and on others Swedish Turnips, were grown; excluding also the Tenth, Eleventh, and Twelfth

Courses, on account of the change in the Mineral Manures used on Plot 2. Averages are also given of the produce of the Tenth, Eleventh, and Twelfth Courses, that is, after the change in the Mineral Manures applied to Plot 2. For full particulars of the manures applied to Plot 2, and also of those applied to Plot 3, see Foot-notes 1, 2, and 3, on pages 101, 103, 105, or 107.

1 lb. (pound avoird.) per acre = (about) 1.12 Kilogramme per Hectare, or 0.57 Zollverein Pfund. per Prussian Morgen
 1 cwt. (hundredweight) per acre = (about) 125.5 Kilogrammes per Hectare, or 0.64 Centner per Pr. Morgen.

Years.	Description of Crop.	Plot 1. Unmanured continuously.			Plot 2. Superphosphate of Lime, alone, Courses 1-9, Complex Mineral Manure, Courses 10-12, for the Turnip Crops only.			Plot 3. Complex Mineral and Nitrogenous Manure, for the Turnip Crops only.		
		Corn (1) (or Roots).	Straw (or Leaf).	Total Produce. (2)	Corn (1) (or Roots).	Straw (or Leaf).	Total Produce. (2)	Corn (1) (or Roots).	Straw (or Leaf).	Total Produce. (2)
PRODUCE PER ACRE.										
1852, '56, '60, '64, '72, '76, '80	Swedish Turnips	16 1/2 cwt.	3 cwt.	19 1/2 cwt.	12 1/2 cwt.	11 1/2 cwt.	13 3/8 cwt.	266 1/2 cwt.	24 3/8 cwt.	280 1/2 cwt.
1853, '57, '61, '65, '69, '73, '77, '81	Barley	32 3/8 bush.	1971 lbs.	3780 lbs.	27 3/8 bush.	1623 lbs.	3196 lbs.	42 3/8 bush.	2547 lbs.	4962 lbs.
1854, '58, '62, '66, '70, '74, '78, '82	{ Clover, 1874, and '82 (as hay)	12 1/2 bush.	1081 lbs.	1867 lbs.	12 1/2 bush.	1200 lbs.	1996 lbs.	21 1/2 bush.	1809 lbs.	3230 lbs.
1855, '59, '63, '67, '71, '75, '79, '83	{ Beans	26 bush.	2762 lbs.	4407 lbs.	28 1/2 bush.	3023 lbs.	4841 lbs.	32 1/2 bush.	3768 lbs.	5847 lbs.
	{ Wheat									
AVERAGE OF 8 COURSES (COURSES 2-9), 1852-1883.										
1884, 1888 and 1892	Swedish Turnips	4 1/2 cwt.	1 1/2 cwt.	6 1/2 cwt.	19 1/2 cwt.	15 1/2 cwt.	20 1/2 cwt.	410 1/2 cwt.	40 1/2 cwt.	451 1/2 cwt.
1885, 1889 and 1893	Barley	13 3/8 bush.	1214 lbs.	1972 lbs.	19 1/2 bush.	1334 lbs.	2412 lbs.	27 1/2 bush.	1928 lbs.	3483 lbs.
1886, 1890 and 1894	{ Clover, 1886 and 1894 (as hay)	7 bush.	603 lbs.	1079 lbs.	24 1/2 bush.	1764 lbs.	3441 lbs.	15 1/2 bush.	1102 lbs.	2145 lbs.
1887, 1891 and 1895	{ Beans, 1890	26 1/2 bush.	2057 lbs.	3707 lbs.	40 1/2 bush.	3314 lbs.	5888 lbs.	41 1/2 bush.	3560 lbs.	6160 lbs.
	{ Wheat									
AVERAGE OF 3 COURSES (COURSES 10, 11, AND 12), 1884-1895.										

SUMMARY OF TABLE I. (pp. 100-1).—Results relating to the portions of each plot from which the turnip-crops were entirely removed; and on which clover or beans were grown.

SUMMARY of TABLE II. (pp. 102-3).—Results relating to the portions of each plot from which the turnip-crops were entirely removed; and on which, in the third year of each course (excepting the first, 1850, when clover was grown), the land was left fallow.

Year	AVERAGE OF 8 COURSES (COURSES 2-9), 1852-1883.												
	Swedish Turnips	Barley	Fallow	Wheat	26 cwts. 30 bush.	3½ cwts. 1792 lbs.	29½ cwts. 3497 lbs.	134½ cwts. 27½ bush.	10½ cwts. 1568 lbs.	144½ cwts. 3131 lbs.	262½ cwts. 40½ bush.	21½ cwts. 2423 lbs.	283½ cwts. 4755 lbs.
1852, '56, '60, '64, '72, '76, '80	•	•	•	•	•	•	•	•	•	•	•	•	•
1853, '57, '61, '65, '69, '73, '77, '81	•	•	•	•	•	•	•	•	•	•	•	•	•
1854, '58, '62, '66, '70, '74, '78, '82	•	•	•	•	•	•	•	•	•	•	•	•	•
1855, '59, '63, '67, '71, '75, '79, '83	•	•	•	•	•	•	•	•	•	•	•	•	•

Year	AVERAGE OF 3 COURSES (COURSES 10, 11, AND 12), 1884-1895.												
	Swedish Turnips	Barley	Fallow	Wheat	14½ cwts. 17 bush.	5½ cwts. 1362 lbs.	19½ cwts. 2233 lbs.	176½ cwts. 13½ bush.	12½ cwts. 1070 lbs.	188½ cwts. 1869 lbs.	417½ cwts. 19½ bush.	36½ cwts. 1452 lbs.	453½ cwts. 2587 lbs.
1884, 1888 and 1892	•	•	•	•	•	•	•	•	•	•	•	•	•
1885, 1889 and 1893	•	•	•	•	•	•	•	•	•	•	•	•	•
1886, 1890 and 1894	•	•	•	•	•	•	•	•	•	•	•	•	•
1887, 1891 and 1895	•	•	•	•	•	•	•	•	•	•	•	•	•

SUMMARY OF TABLE III. (pp. 104-5).—Results relating to the portions of each plot on which the turnip-crops were either fed off by sheep, or cut and spread on the land; and on which clover or beans were grown.

Year	AVERAGE OF 8 COURSES (COURSES 2-9), 1852-1883.												
	Swedish Turnips	Barley	Fallow	Wheat	15½ cwts. 28 bush.	2½ cwts. 1758 lbs.	17½ cwts. 3351 lbs.	150½ cwts. 38 bush.	12½ cwts. 2250 lbs.	168½ cwts. 4417 lbs.	262½ cwts. 47½ bush.	24½ cwts. 3146 lbs.	287½ cwts. 5903 lbs.
1852, '56, '60, '64, '72, '76, '80	•	•	•	•	•	•	•	•	•	•	•	•	•
1853, '57, '61, '65, '69, '73, '77, '81	•	•	•	•	•	•	•	•	•	•	•	•	•
1854, '58, '62, '66, '70, '74, '78, '82	•	•	•	•	•	•	•	•	•	•	•	•	•
1855, '59, '63, '67, '71, '75, '79, '83	•	•	•	•	•	•	•	•	•	•	•	•	•

Year	AVERAGE OF 3 COURSES (COURSES 10, 11, AND 12), 1884-1895.												
	Swedish Turnips	Barley	Fallow	Wheat	8½ cwts. 14½ bush.	2½ cwts. 1201 lbs.	11½ cwts. 1997 lbs.	236 cwts. 27½ bush.	18½ cwts. 1812 lbs.	253½ cwts. 3373 lbs.	344½ cwts. 31½ bush.	37½ cwts. 2505 lbs.	381½ cwts. 4350 lbs.
1884, 1888 and 1892	•	•	•	•	•	•	•	•	•	•	•	•	•
1885, 1889 and 1893	•	•	•	•	•	•	•	•	•	•	•	•	•
1886, 1890 and 1894	•	•	•	•	•	•	•	•	•	•	•	•	•
1887, 1891 and 1895	•	•	•	•	•	•	•	•	•	•	•	•	•

SUMMARY OF TABLE IV. (pp. 106-7).—Results relating to the portions of each plot on which the turnip-crops were either fed off by sheep, or cut and spread on the land; and on which, in the third year of each course (excepting the first, 1850, when clover was grown), the land was left fallow.

Year	AVERAGE OF 8 COURSES (COURSES 2-9), 1852-1883.												
	Swedish Turnips	Barley	Fallow	Wheat	24 cwts. 1784 lbs.	2½ cwts. 3081 lbs.	26½ cwts. 3491 lbs.	150½ cwts. 38½ bush.	11 cwts. 2116 lbs.	161½ cwts. 4148 lbs.	269½ cwts. 48½ bush.	22½ cwts. 3253 lbs.	292 cwts. 6018 lbs.
1852, '56, '60, '64, '72, '76, '80	•	•	•	•	•	•	•	•	•	•	•	•	•
1853, '57, '61, '65, '69, '73, '77, '81	•	•	•	•	•	•	•	•	•	•	•	•	•
1854, '58, '62, '66, '70, '74, '78, '82	•	•	•	•	•	•	•	•	•	•	•	•	•
1855, '59, '63, '67, '71, '75, '79, '83	•	•	•	•	•	•	•	•	•	•	•	•	•

Year	AVERAGE OF 3 COURSES (COURSES 10, 11, AND 12), 1884-1895.												
	Swedish Turnips	Barley	Fallow	Wheat	18½ cwts. 19½ bush.	5½ cwts. 1468 lbs.	25½ cwts. 2871 lbs.	200½ cwts. 17½ bush.	13½ cwts. 1287 lbs.	213½ cwts. 2828 lbs.	406½ cwts. 27½ bush.	37½ cwts. 2178 lbs.	444½ cwts. 3745 lbs.
1884, 1888 and 1892	•	•	•	•	•	•	•	•	•	•	•	•	•
1885, 1889 and 1893	•	•	•	•	•	•	•	•	•	•	•	•	•
1886, 1890 and 1894	•	•	•	•	•	•	•	•	•	•	•	•	•
1887, 1891 and 1895	•	•	•	•	•	•	•	•	•	•	•	•	•

(1) The quantities given in *Bushels* represent the *Dressed* Corn only. (2) The "Total Produce" of the Corn-crops includes Dressed Corn, Oat, Corn, Straw, and Chaff.