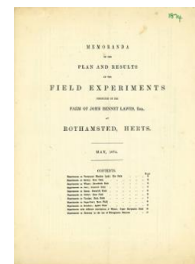


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Memoranda of the Field Experiments at Rothamsted May 1874



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1874

MEMORANDA
OF THE
PLAN AND RESULTS
OF THE
FIELD EXPERIMENTS
CONDUCTED ON THE
FARM OF JOHN BENNET LAWES, Esq.,
AT
ROTHAMSTED, HERTS.

MAY, 1874.

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THE PARK.

EXPERIMENTS WITH DIFFERENT MANURES ON PERMANENT MEADOW LAND.

The Land has probably been laid down with Grass for some centuries. No fresh seed has been artificially sown within the last 40 years certainly; nor is there record of any having been sown since the Grass was first laid down. The experiments commenced in 1856, at which time the character of the herbage appeared uniform over all the Plots. Excepting as explained in the Table and in the foot-notes, the same description of Manure has been applied year after year to the same Plot.

(Area under experiment, about 7 acres.)

PLOTS.	Manures, per acre, per Annum.	Produce per Acre, weighted as Hay.					Average per Annum; 1856-1873.
		18th Season; 1870.	18th Season; 1871.	17th Season; 1872.	16th Season; 1873.	Cwts.	
1	{1856-63, 8 years, 14 tons Farmyard Manure, and 200 lbs. Ammonia-salts; average produce 49½ cwt. } {1864 and since, 200 lbs. Ammonia-salts alone; average produce (10 years, 1864-73) 40½ cwt. }	61	16½	43½	31½	29½	44½
2	{1856-63, 8 years, 14 tons Farmyard Manure; average produce 42½ cwt. } {1864 and since, unmanured; average produce (10 years, 1864-73) 35½ cwt. }	55½	13½	33½	25½	18½	38½
3	Unmanured, continuously	38	5½	25½	14½	12½	21½
4	3½ cwt. Superphosphate of Lime (a)	40½	7½	24½	15½	13½	23½
4	3½ cwt. Superphosphate of Lime (a)	45½	8½	38½	28½	26	35½
	400 lbs. Ammonia-salts	55½	5½	29½	22½	16½	27½
5	{1856-63, 13 years, 400 lbs. Ammonia-salts; average produce 30½ cwt. } {1869 and since, 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphos.; av. prod. (5 yrs., 1869-73) 39½ cwt. }	56½	16½	37½	25½	26	31½
6	300 lbs. Sulphate Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwt. Superphosphate	54½	17½	39½	37½	34½	35½
7	{1856-61, 6 years, 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwt. Superphosphate } {1862 and since, 250 lbs. Sulphate Potass, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate; average produce (12 years, 1862-73) 28½ cwt. }	46½	12½	30	22½	18½	31
8	300 lbs. Sulphate Potass, 100 lbs. Sulphate Magnesia, and 400 lbs. Ammonia-salts	68½	29½	58½	50½	43½	52½
9	{1856-61, 6 yrs., 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphos., 400 lbs. Amm.-salts; av. prod. 55½ cwt. } {1862 and since, 250 lbs. Sulph. Potass, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphos., 400 lbs. Amm.-salts; av. prod. (12 yrs., 1862-73) 43½ cwt. }	57½	21½	46½	38½	33	47½
10	{300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosph., 800 lbs. Ammonia-salts } {300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosph., 800 lbs. Ammonia-salts, and 400 lbs. Silicate Soda (b)	75½	42½	56½	63½	46½	60½
11	Unmanured continuously	78½	49½	65½	63½	56½	65½
12	300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwt. Superphosphate	38½	11½	26½	20½	16½	24½
13	300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosphate, and 400 lbs. Ammonia-salts	77½	48	63	62½	57	57½
14	550 lbs. Nitrate of Soda (c), 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate	76½	56½	61½	55½	51½	57½
15	550 lbs. Nitrate of Soda	53½	15½	38½	32½	33½	36½
16	275 lbs. Nitrate of Soda, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate	74½	33½	57	40	41½	47½
17	275 lbs. Nitrate of Soda	54½	19½	38½	29½	28½	34½
18	Mixture supplying the quantity of Potass, Soda, Lime, Magnesia, Phosphoric acid, Silica, and Nitrogen, contained in 1 ton of Hay (commencing 1865)	55½	14½	37½	33½	26½	33
19	275 lbs. Nitrate of Soda, 200 lbs. Sulphate of Potass, and 3½ cwt. Superphosphate (commencing 1872)	..	..	..	..	40	38½
20	327 lbs. Nitrate of Potass, and 3½ cwt. Superphosphate (commencing 1872)	..	..	..	..	38½	37½

(1) "Ammonia-salts"—In all cases equal parts Sulphate and Murate of Ammonia of Commerce.
 (2) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, gr. 1-7 (and water).
 (3) Plots 6, 8, and 10, had, besides the Manures specified, 2000 lbs. Sawdust per acre per annum for the first 7 years, 1856-1862, but without effect.
 (4) 200 lbs. 1856-1862, but without effect.
 (5) 500 lbs. in 1862 and 1863.
 (6) Only 400 lbs. in 1863-60-61.
 (7) The application of Silicates did not commence until 1862.
 (8) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. of "Ammonia-salts."
 (9) Average of 15 years only, as the manures specified were first applied in 1859 (previously, 1856-7 and 8, Sawdust only).
 (10) Average of 16 years only, as these experiments did not commence until 1858.
 (11) Average of 9 years only, as the experiment only commenced in 1866.

HOOS FIELD.

EXPERIMENTS ON THE GROWTH OF BARLEY YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE. Previous Cropping—1847, Swedish Turnips, with Dung and Superphosphate of Lime, the Roots carted off; 1848, Barley; 1849, Clover; 1850, Wheat; 1851, Barley manured with Ammonia-salts. First Experimental Barley Crop in 1852. Barley every year since; and, unless stated to the contrary in the Table, or in the foot-notes, the same Manure has been applied year after year to the same Plot.

(Area under experiment, about 4½ acres.)

PLOTS.	Manures, per acre, per annum.	PRODUCE PER ACRE.						PLOTS.
		Averages per Annum, over 20 Years, 1852-1871.			Twenty-second Season, 1873.			
		Quantity.	Weight per Bushel.	Total Straw.	Quantity.	Weight per Bushel.	Total Straw.	
1 O.	Unmanured continuously	20	52½	11½	14	55½	1 O.	
2 O.	3½ cwt. Superphosphate of Lime (1)	25	53½	13½	19½	54½	2 O.	
3 O.	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia	22½	53	12½	15	54½	3 O.	
4 O.	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphosphate	27½	53½	14½	20½	54½	4 O.	
1 A.	200 lbs. Ammonia-salts (2)	32½	59½	18½	32½	54½	1 A.	
2 A.	200 lbs. Ammonia-salts, and 3½ cwt. Superphosphate	47	55½	27½	50½	54½	2 A.	
3 A.	200 lbs. Ammonia-salts, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia	35	54½	20½	34½	55½	3 A.	
4 A.	200 lbs. Ammonia-salts, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosphate	46½	54	28½	46½	55½	4 A.	
(1) A.A.	275 lbs. Nitrate Soda	37	52	22½	37½	54½	1 A.A.	
(2) A.A.	275 lbs. Nitrate Soda, and 3½ cwt. Superphosphate	49½	53½	30½	49	54½	2 A.A.	
(3) A.A.	275 lbs. Nitrate Soda, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia	37½	52½	24½	33½	54½	3 A.A.	
(4) A.A.	275 lbs. Nitrate Soda, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosphate	49½	53½	32½	46½	54½	4 A.A.	
(1) A.A.S.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (3)	38	52½	23½	45½	54½	1 A.A.S.	
(2) A.A.S.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, and 3½ cwt. Superphosphate (1)	48½	53½	30½	51½	54½	2 A.A.S.	
(3) A.A.S.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, and 100 lbs. Sulph. Magnesia	41½	53½	25½	44½	54½	3 A.A.S.	
(4) A.A.S.	(275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwt. Superphosphate	50½	53½	33½	51½	54½	4 A.A.S.	
(1) C.	1000 lbs. Rape-cake	45½	53½	26½	47	54½	1 C.	
(2) C.	1000 lbs. Rape-cake, and 3½ cwt. Superphosphate	48½	53½	28½	48½	54½	2 C.	
(3) C.	1000 lbs. Rape-cake, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia	43½	53½	27½	44½	54½	3 C.	
(4) C.	1000 lbs. Rape-cake, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwt. Superphosphate	47½	53½	29½	46½	54½	4 C.	
(1) N.	275 lbs. Nitrate of Soda	37½	52½	22½	42½	54½	1 N.	
(2) N.	275 lbs. Nitrate of Soda	41½	52½	26½	44½	54½	2 N.	
5 O.	200 lbs. Sulphate of Potass, 3½ cwt. Superphosphate (4)	22½	53½	12½	17½	54½	5 O.	
5 A.	200 lbs. Sulphate of Potass, 3½ cwt. Superphosphate, and 200 lbs. Ammonia-salts	28	53½	15½	23½	54½	5 A.	
M.	100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, and 3½ cwt. Superphosphate	21½	53½	12½	20	53½	M.	
6(1)	Unmanured continuously	22	52½	12½	15½	53½	7½	
6(2)	Ashes (burnt soil and turf)	21½	52½	12½	18½	54½	8½	
7(1)	Farmyard Manure 14 tons, 20 years, 1852-1871; unmanured since	48½	54½	28½	47½	54½	22½	
7(2)	Farmyard Manure 14 tons, every year	48½	54½	28½	54½	54½	30½	

(1) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1.7 (and water).
 (2) 300 lbs. per annum for the first six years, 1852-7.
 (3) 200 lbs. per annum for the first six years, 1852-7.
 (4) The "Ammonia-salts" — in all cases equal to 400 lbs. Ammonia-salts per annum; next 10 years, 1858-67, 200 lbs. per annum; 1868, and since, 275 lbs. Nitrate of Soda per annum. 275 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 200 lbs. "Ammonia-salts."
 (5) The application of Silicates did not commence until 1864; in 1864-5-6 and 7, 200 lbs. Silicate of Soda, and 200 lbs. Silicate of Lime were applied per acre, but in 1868, and since, 400 lbs. Silicate of Soda, and no Silicate of Lime. These plots ("A.A.S.") comprise, respectively, one half of the original "A.A." plots, and

BROADBALK FIELD.

EXPERIMENTS ON THE GROWTH OF WHEAT YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE. Previous Cropping—1839, Turnips, with Farmyard Manure; 1840, Barley, 1841, Peas; 1842, Wheat; 1843, Oats; the last four Crops Unmanured. First Experimental Wheat Crop in 1844. Wheat every year since; and, with some exceptions, nearly the same description of Manure on the same Plots each year—especially during the last 23 years (1852 and since). Unless otherwise stated, the Manures are sown in the Autumn before the seed. (Area under experiment, about 13 acres.)

Plots.	Manures, per acre, per annum.	PRODUCE PER ACRE.							
		Average per Annum, 20 Years, 1852-1871.			Thirtieth Season, 1873.				
		Dressed Corn.		Total Straw.	Dressed Corn.		Total Straw.		
		Quantity.	Weight per Bushel.	Quantity.	Weight per Bushel.	Quantity.	Weight per Bushel.		
0	Superphosphate of Lime (three times as much as on No. 5 and succeeding Plots)	17 1/2	58 1/2	15 1/2	57 1/2	15 1/2	57 1/2	10 1/2	0
1	Sulphates of Potass, Soda, and Magnesia (twice as much as on No. 5 and succeeding Plots)	15 1/2	58 1/2	13 1/2	56 1/2	10 1/2	56 1/2	8 1/2	1
2	Farmyard Manure (14 tons every year)	35 1/2	60 1/2	33 1/2	58 1/2	23 1/2	58 1/2	22	2
3	Unmanured continuously	14 1/2	57 1/2	13 1/2	57 1/2	11 1/2	57 1/2	8	3
4	Unmanured for Crop of 1852, and since; previously Superphosphate (made with Muriatic Acid), and Sulphate Ammonia	15 1/2	58 1/2	13 1/2	57 1/2	19 1/2	57 1/2	8 1/2	4
5 (a and b)	200 lbs. (c) Sulphate Potass, 100 lbs. (c) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3 1/2 cwt. Superphosphate of Lime (c)	17	58 1/2	15 1/2	58 1/2	13 1/2	56 1/2	9 1/2	5 (a and b)
6 (a and b)	200 lbs. (c) Sulphate Potass, 100 lbs. (c) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3 1/2 cwt. Superphosph., and 200 lbs. Ammonia-salts (c)	26 1/2	59 1/2	24 1/2	57 1/2	15 1/2	57 1/2	13 1/2	6 (a and b)
7 (a and b)	200 lbs. (c) Sulphate Potass, 100 lbs. (c) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3 1/2 cwt. Superphosph., and 400 lbs. Ammonia-salts	35 1/2	59 1/2	35 1/2	57 1/2	22	57 1/2	18	7 (a and b)
8 (a and b)	200 lbs. (c) Sulphate Potass, 100 lbs. (c) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3 1/2 cwt. Superphosph., and 600 lbs. Ammonia-salts	38 1/2	59 1/2	41 1/2	56 1/2	27 1/2	56 1/2	23 1/2	8 (a and b)
9 {a b	200 lbs. (c) Sulphate Potass, 100 lbs. (c) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3 1/2 cwt. Superphosph., and 650 lbs. Nitrate Soda (c)	36 1/2	58 1/2	41 1/2	57 1/2	35 1/2	57 1/2	25 1/2	9 {a b
10 {a b	550 lbs. Nitrate of Soda (c). (The Nitrate for both 9a and 9b always sown in the Spring.)	28 1/2	57 1/2	21 1/2	56 1/2	21 1/2	54 1/2	21	10 {a b
11 (a and b)	400 lbs. Ammonia-salts alone, for 1845, and each year since; Mineral Manure in 1844	22 1/2	57 1/2	19 1/2	56 1/2	14 1/2	56 1/2	14 1/2	11 (a and b)
12 (a and b)	400 lbs. Ammonia-salts alone, for 1845, and each year since (excepting 1846 and 1850); Mineral Manure in 1844, 48, and 50	25 1/2	58 1/2	24 1/2	56 1/2	14 1/2	56 1/2	14 1/2	12 (a and b)
13 (a and b)	400 lbs. Ammonia-salts, 3 1/2 cwt. Superphosphate	28	57 1/2	26 1/2	55 1/2	19 1/2	55 1/2	14 1/2	13 (a and b)
14 (a and b)	400 lbs. Ammonia-salts, 3 1/2 cwt. Superphosphate, and 366 1/2 lbs. (c) Sulphate of Soda	33 1/2	59 1/2	32 1/2	57 1/2	22 1/2	56 1/2	17 1/2	14 (a and b)
15 {a b	400 lbs. Ammonia-salts, 3 1/2 cwt. Superphosphate, and 280 lbs. (c) Sulphate of Magnesia	33 1/2	59 1/2	33 1/2	57 1/2	23 1/2	57 1/2	18 1/2	15 {a b
16 (a and b)	200 lbs. (c) Sulph. Pot., 100 lbs. (c) Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphosph. (c); 400 lbs. Amm.-salts, sown in Spring (c)	32 1/2	59 1/2	32 1/2	57 1/2	24 1/2	56 1/2	19 1/2	16 (a and b)
(c) {17 (a and b) 18 (a and b)	200 lbs. (c) Sulph. Pot., 100 lbs. (c) Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphosph. (c); 400 lbs. Amm.-salts, sown in Spring (c)	34	59 1/2	33 1/2	57 1/2	25 1/2	57 1/2	20 1/2	(c) {17 (a and b) 18 (a and b)
19	1852-54, 13 years, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphosph., and 800 lbs. Ammonia-salts; average produce 39 1/2 bush. Corn, 46 1/2 cwt. Straw	32 1/2	59	36 1/2	57 1/2	19 1/2	57 1/2	10 1/2	19
20	1865 and since, unmanured; average produce (9 years, 1865-73) 17 1/2 bushels Corn, 1 1/2 cwt. Straw	31 1/2	59 1/2	31 1/2	57 1/2	11 1/2	57 1/2	9 1/2	20
21	3 1/2 cwt. Superphosphate of Lime (c), 300 lbs. Sulphate of Ammonia, and 500 lbs. Rape-cake	17 1/2	58 1/2	16 1/2	57 1/2	20 1/2	57 1/2	16 1/2	21
22	Unmanured continuously	15 1/2	58 1/2	14 1/2	56 1/2	19 1/2	56 1/2	11 1/2	22

(1) 300 lbs. per annum for Crop of 1858, and previously.
 (2) 200 lbs. per annum for Crop of 1858, and previously.
 (3) Superphosphate of Lime—in all cases, excepting for Plot 19, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid, sp. gr. 1.7 (and water).
 (4) Ammonia-salts, in all cases, equal parts Sulphate and Muriate of Ammonia of Commerce.
 (5) 9a, 47 1/2 lbs. Nitrate Soda, in 1852, 275 lbs. in 1853, and 1854, 550 lbs. each year since; 9b, 47 1/2 lbs. in 1852; 550 lbs. each year since; 550 lbs. is reckoned to contain the same amount of Nitrogen as 400 lbs. Ammonia-salts.
 (6) For 1858, and previously—1 1/2 times as much.
 (7) For 1872 and previously, made with Muriatic instead of Sulphuric Acid.
 (8) For 1872 and previously, 400 lbs. Sulphate Ammonia, sown in the Autumn.
 (9) For 1872 and previously, 300 lbs. Sulphate Ammonia and 500 lbs. Rape-cake, sown in the Autumn.
 (10) The Minures of Plots 17 and 18 are, year by year, transposed.
 (11) Made with Muriatic instead of Sulphuric Acid.
 (12) Average of 20 years' Ammonia-salts, alternated with Mineral Manures.
 (13) Average of 20 years' Mineral Manures, alternated with Ammonia-salts.
 (14) Plots 17 had the Mineral Manures for the Crop of 1873.
 (15) Average of 19 years only; as, in 1869, owing to a mistake in carting, the produce could not be ascertained.
 (16) The Plots marked "a" and "b" are divided into duplicate portions, "a" and "b," respectively, which are manured alike, excepting that, for the crop of 1861-63 and 7, the "a" portions of plots 5, 6, 7, 8, 9, 10, and 17 (or 18), received a quantity of soluble Silicates in addition to the other Manures, but, hitherto, without any material effect; and for the crops of 1868, and all since, the produce in the portions marked "a" in the present season) has been applied (instead of Silicates) on the "a" portions of plots 5, 6, 7, 8, 11, 12, 13, 14, and 17 (or 18).

GEESCROFT FIELD.

EXPERIMENTS ON THE GROWTH OF OATS YEAR AFTER YEAR ON THE SAME LAND; WITHOUT MANURE, AND WITH DIFFERENT KINDS OF MANURE.

Previous Cropping—1847 and 1848, Clover, Experimental Manures; 1849—1859, Beans, Experimental Manures; 1860, Fallow; 1861 and 1862, Wheat, Unmanured; 1863, Fallow; 1864, Beans, Dunged; 1865, Wheat, Unmanured; 1866, Beans, Unmanured; 1867 and 1868, Wheat, Unmanured. First Experimental Oat Crop in 1869.

(Area under Experiment, $\frac{1}{2}$ acre.)

PLOTS.	MANURES, PER ACRE, PER ANNUM.	PRODUCE PER ACRE.											
		1ST SEASON, 1869.		2ND SEASON, 1870.		3RD SEASON, 1871.		4TH SEASON, 1872.		5TH SEASON, 1873.		AVERAGE PER ANNUM 5 YEARS, 1869-1873.	
		Dressed Corn.	Total Straw.	Dressed Corn.	Total Straw.	Dressed Corn.	Total Straw.	Dressed Corn.	Total Straw.	Dressed Corn.	Total Straw.	Dressed Corn.	Total Straw.
1	Unmanured	Bushels, 36 $\frac{1}{2}$	cwts. 19 $\frac{1}{2}$	Bushels, 16 $\frac{1}{2}$	cwts. 9 $\frac{1}{2}$	Bushels, 20 $\frac{1}{2}$	cwts. 11 $\frac{1}{2}$	Bushels, 15	cwts. 7 $\frac{1}{2}$	Bushels, 10 $\frac{1}{2}$	cwts. 5 $\frac{1}{2}$	Bushels, 19 $\frac{1}{2}$	cwts. 10 $\frac{1}{2}$
2	{ 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3 $\frac{1}{2}$ cwts. Superphosphate of Lime ⁽¹⁾ }	45	24 $\frac{1}{2}$	19 $\frac{1}{2}$	9 $\frac{1}{2}$	22	13 $\frac{1}{2}$	19 $\frac{1}{2}$	10 $\frac{1}{2}$	17	8 $\frac{1}{2}$	24 $\frac{1}{2}$	13 $\frac{1}{2}$
3	400 lbs. Ammonia-salts ⁽²⁾ }	56 $\frac{1}{2}$	36 $\frac{1}{2}$	30	17 $\frac{1}{2}$	57 $\frac{1}{2}$	40 $\frac{1}{2}$	55 $\frac{1}{2}$	30 $\frac{1}{2}$	36 $\frac{1}{2}$	16 $\frac{1}{2}$	47	28 $\frac{1}{2}$
4	{ 400 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3 $\frac{1}{2}$ cwts. Superphosphate .. }	75 $\frac{1}{2}$	54	50 $\frac{1}{2}$	28 $\frac{1}{2}$	58 $\frac{1}{2}$	50	62 $\frac{1}{2}$	45 $\frac{1}{2}$	48 $\frac{1}{2}$	27 $\frac{1}{2}$	59	41 $\frac{1}{2}$
5	550 lbs. Nitrate of Soda ⁽³⁾ }	62 $\frac{1}{2}$	42 $\frac{1}{2}$	38 $\frac{1}{2}$	28	55	34 $\frac{1}{2}$	42 $\frac{1}{2}$	20 $\frac{1}{2}$	39 $\frac{1}{2}$	16 $\frac{1}{2}$	47 $\frac{1}{2}$	27 $\frac{1}{2}$
6	{ 550 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3 $\frac{1}{2}$ cwts. Superphosphate .. }	69 $\frac{1}{2}$	49 $\frac{1}{2}$	50	28 $\frac{1}{2}$	60 $\frac{1}{2}$	48 $\frac{1}{2}$	44 $\frac{1}{2}$	24	63 $\frac{1}{2}$	24	57 $\frac{1}{2}$	35

6TH SEASON, 1874.

Only 200 lbs. instead of 400 lbs. Ammonia-salts to Plots 3 and 4, and only 275 lbs. instead of 550 lbs. Nitrate of Soda to Plots 5 and 6; in all other respects the manures are the same as in previous years, and as stated above.

(¹) "Superphosphate of Lime"—in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1.7 (and water).
 (²) "Ammonia-salts"—in each case, equal parts Sulphate and Murate of Ammonia of Commerce.
 (³) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."

EXPERIMENTS ON THE GROWTH OF LEGUMINOUS CROPS.

I.—BEANS, PEAS, AND TARES—GEESCROFT FIELD.

EXPERIMENTS on the growth of Leguminous corn-crops (beans, peas, and tares), with different descriptions of manure, were commenced in 1847, about nine acres being devoted to the purpose.

Experiments with BEANS were continued for thirteen consecutive seasons, to 1859 inclusive; but, during the later years, the crop fell off very much, and the land became very foul.

In 1860 the land was fallowed.

In 1861 a crop of wheat, without manure, was taken.

In 1862 beans were again sown, but with some variation in the manuring.

In 1863 the land was fallowed.

In 1864, 5, 6, 7, 8, and 9, beans were grown, with much the same manures on the same plots, each year, as in 1862.

In the winter of 1869-70, 5000 lbs. of fresh burnt lime were applied per acre, over all the plots.

In 1870 beans were grown with the same manures on the respective plots as in 1864-69.

In October, 1870, winter beans were sown (without manure), but the plants were to so great an extent destroyed by the severe weather which followed, that, in April 1871, the crop was ploughed up, and the land left fallow.

During the winter and early spring of 1871-2, the land was so wet that it could not be prepared in time for sowing. It was therefore left fallow for 1872, at the end of May subsoiled to a depth of about 12 inches, and re-ploughed in July. The winter and early spring of 1872-3 were also so extremely wet, that it was again impossible to prepare the land in time for sowing; it was, however, ploughed up towards the end of March, again left fallow, and re-ploughed in July and October (1873). On February 2, 1874, the land was again set with Beans, but without manure.

The general result of the experiments with BEANS has been, that mineral constituents used as manure (more particularly potass), increased the produce very much during the early years; and, to a certain extent, afterwards, whenever the season was favourable for the crop. Ammonia-salts, on the other hand, produced very little effect; notwithstanding that a Leguminous crop contains two, three, or more times as much nitrogen as a Gramineous one grown under similar conditions as to soil, &c. Nitrate of soda has, however, produced marked effects. But Leguminous crops grown too frequently on the same land seem to be peculiarly subject to disease, which no conditions of manuring that we have hitherto tried seem to obviate.

Experiments with PEAS were soon abandoned, owing to the difficulty of keeping the land free from weeds, and an alternation of BEANS and WHEAT was substituted; the beans being manured much as in the experiments with the same crop grown continuously as above described. But the wetness of the winter of 1871-72 prevented the sowing of the Beans for the season of 1872; and again the wetness of the autumn and winter of 1872-3 prevented the sowing of the wheat until April 4, 1873, when Nursery wheat was put in, which, however, did not come to maturity, but was cut in the middle of September, yielding about 27 cwt. of gross produce per acre, containing too little corn to be worth thrashing. The land was ploughed in October 1873, and sown with beans February 3, 1874.

In alternating WHEAT with BEANS, the remarkable result had been obtained, that nearly as much wheat, and nearly as much nitrogen, were yielded in eight crops of wheat in alternation with the highly nitrogenous beans, as in sixteen crops of wheat grown consecutively without manure in another field, and also nearly as much as were obtained in a third field in eight crops alternated with bare fallow.

Experiments with TARES, like those with Peas, were soon abandoned, and for the same reasons. Beans were at first substituted, with some variation in the description of the manures employed; but this experiment has likewise been abandoned for some years.

II.—RED CLOVER (*Trifolium pratense*)—HOOS FIELD.

EXPERIMENTS on the growth of Clover, with many different descriptions of manure, were commenced in 1849, and, with the occasional interposition of a corn-crop, or fallow, have been continued up to the present time.

As with other Leguminous crops, the result was, that mineral constituents applied as manure (particularly potass) considerably increased the early crops; whereas ammonia-salts had little or no beneficial effect, and were sometimes injurious. It may be added that, even up to the present time, the beneficial effects of long previous applications of potass are apparent whenever there is any growth at all. To go a little more into detail:—

In the first year, 1849, the crops were throughout very heavy; especially with mineral, and without nitrogenous manure.

In autumn 1849 wheat was sown, and in spring 1850 Red Clover. In 1851 small cuttings were taken; and in 1852, though the crops were not heavy, there was by no means a failure. Since that time, however, all attempts to grow clover year after year on the same land have failed to give anything like a full crop, or a plant which would stand the usual time on the ground. Small cuttings were obtained in the autumns of 1855 and 1859 from seed sown in the spring of those years, and small but rather heavier cuttings in June and August 1865, from seed sown in 1864.

On two occasions (1851 and 1854), heavy dressings of Farmyard dung were applied to some of the plots; and in 1854 some received a dressing of 20 tons of dung, and 5000 lbs. of lime, per acre.

On some portions of the land Clover-seed was sown 10 times during the 23 years, 1848-1870 inclusive, and more frequently alone than with a corn-crop; but in 7 out of the last 8 trials the plant died off in the winter and spring succeeding the sowing the seed.

In view of these failures in the field, it is a fact of much interest, that in 1854 Red Clover was sown in a garden, only a few hundred yards distant from the experimental field, on soil which has been under ordinary garden cultivation for probably two or three centuries, and it has every year since shown very luxuriant growth; and, after re-sowing 4 times during the period, namely, in 1860, 1865, 1868, and 1871, a small cutting was taken in the autumn of 1871, two cuttings in 1872, and two in 1873. Notwithstanding some injury from dodder in 1873, there still remained too much plant to break up; and, accordingly, fresh seed has just (May 4, 1874) been sown between the rows. This, therefore, is the 21st season of the growth of Clover, year after year, on this plot of garden ground.

In reference to the field experiments, it may be added that, in 1864, a portion of the land was trenched 2 feet deep, and one-third of the manure was mixed with the layer from 24 to 16 inches, one-third from 16 to 8 inches, and the remainder from 8 inches upwards. Owing to the characters of the season, the mechanical condition of the land was at first very unfavourable after this treatment; but, although many years have now elapsed, and the excess of constituents supplied was in some cases considerable, the plant has died off as completely on these plots as elsewhere.

Again, in the winter of 1867-8 small portions of the experimental land were dug, some to the depth of 9 inches, some to the depth of 18, some to the depth of 27, and some to the depth of 36 inches, and sown to the respective depths with different mixtures; supplying in some cases very large amounts of potass, soda, lime, magnesia, phosphoric acid, sulphuric acid, nitrate of soda, &c. From other similar sized plots, the soil was removed to the depths of 9, 18, and 27 inches respectively, and replaced by soil taken at the same depths from the garden border, on a portion of which clover had been grown successfully since 1854, as above referred to. In April 1868 clover was sown over the whole of these small plots, and on some other portions of the land not so treated; but the plant for the most part died off during the following winter.

In April 1869 the same portions were re-sown, small quan-

titles of clover were cut in September of that year, but the plant again died off in the winter.

In April 1870 Clover was sown over the whole of the experimental land, this time in conjunction with Barley; but on those portions which had also been sown in 1868 and 1869 the plant again died off during the winter and early spring; whilst from those which had not been sown in 1868 and 1869 two small cuttings were taken in 1871. In the spring of 1872, the plant being then almost entirely gone, the land was ploughed up. It was again ploughed in July 1872, and in March 1873; the intention being to sow some other leguminous crop; but owing to the wetness and lateness of the season this was not done; the land was again left fallow, and re-ploughed in the beginning of June and the end of July (1873). On May 4, 1874, the land was again ploughed, prepared for sowing, and sown with Red Clover seed May 5, without manure.

In the spring of 1871 the *small* plots in the field were again re-sown, and those of the garden-soil were entirely enclosed, both around and above, by galvanised wire netting. Small cuttings were taken from these small beds in July 1872, and (excepting from the garden-soil plots, which had yielded considerably more than the others in 1872) larger cuttings were taken in July 1873. The produce was the largest where potass and nitrate of soda were employed, and where they were applied in the largest quantity, and at the greatest depths. In April 1874, there was still some healthy plant on all the plots, but it was considered to be too irregular to preserve. It has, therefore, been dug in, the artificially-manured plots remanured as before, but only to the depth of 9 inches, and resown with seed on May 4th. More small plots have also been arranged; on which the manures were dug in, at the various depths, on May 11th to 14th, and the seed sown on May 16th.

The general result of the experiments in the field has been—that neither organic matter rich in carbon as well as other constituents, nor ammonia-salts, nor nitrate of soda, nor mineral constituents, nor a complex mixture, supplied as manure, availed to restore the clover-yielding capabilities of the land; though, where some of these were applied in large quantity, and at considerable depths, the result was better than when they were used in only moderate quantities and applied only on the surface.

On the other hand, it is clear that the garden-soil has sup-

plied the conditions under which clover can be grown year after year on the same land for many years in succession.

The results obtained on the garden-soil seem to show that what is called "clover-sickness," cannot be due to the injurious influence of excreted matters upon the immediately succeeding crop.

That Clover frequently fails coincidently with injury from parasitic plants, or insects, cannot be disputed; but it may be doubted whether such injury should be reckoned as the cause, or merely the concomitant and an aggravation, of the failing condition.

The results of the experiments seem, therefore, to exclude the supposition that the primary cause of failure is either destruction by parasitic plants or insects, injury from excreted matters, or the shade of a corn-crop, and to indicate that it must be looked for in exhaustion of the soil. Still there remain several open questions. Is it exhaustion of certain organic matters rich in carbon, of nitrogenous food, or of mineral constituents? Again: is there an absolute deficiency in the soil of some of the substances in question, or only an unfavourable condition of combination, or, so to speak, of *soil-digestion* of them, for the requirements of Leguminous plants? Or, is there only an unfavourable distribution of them within the soil, considered in relation to the extent and character of the root-range of the crop?

These various suggestions cannot be further considered within the limits of this brief notice, which may be concluded by the following quotation from Rothamsted papers on the subject ('Journal Royal Agricultural Society of England,' vol. xxi. Part I. p. 178; and 'Journal Royal Horticultural Society of London,' vol. iii. p. 86, 1872).

"When land is not what is called 'clover-sick,' the crop of clover may frequently be increased by top-dressings of manure containing potass and superphosphate of lime; but the high price of salts of potass, and the uncertainty of the action of manures upon the crop, render the application of artificial manures for clover a practice of doubtful economy.

"When the land is what is called 'clover-sick,' none of the ordinary manures, whether 'artificial' or natural, can be relied upon to secure a crop.

"So far as our present knowledge goes, the only means of insuring a good crop of Red Clover is to allow some years to elapse before repeating the crop upon the same land."

BARN FIELD.

EXPERIMENTS ON THE GROWTH OF ROOT-CROPS.

EXPERIMENTS with TURNIPS were commenced in 1843. Eight acres, divided into numerous plots, were set apart for the purpose; and the crop was grown for ten consecutive years on the same land ("Norfolk Whites" 1843-1848, and "Swedes" 1849-1852); on some plots without manure, and on others with different descriptions of manure. Barley was then grown for three consecutive seasons (1853-1855) without manure, in order to test the comparative corn-growing condition of the different plots, and also to equalize their condition, as far as possible, by the exhaustion of some of the most active and immediately available constituents supplied by the previous manuring. A new series of experiments with Swedes was then arranged, having regard to the character of the manures previously applied on the different plots, and to the results previously obtained. This second series was commenced in 1856, and continued for 15 years—namely, to 1870 inclusive.

It is impossible adequately to state the bearing of the results in a few words, but the following are some of the most characteristic indications:—

1. Without manure of any kind, the produce of roots was reduced in a few years to a few cwts. per acre; but the diminutive plants (both root and leaf) contained a very unusually high percentage of nitrogen.

2. Of "mineral" constituents, phosphoric acid (in the form of superphosphate of lime) was by far the most effective manure; but, when this manure is used alone, the immediately available nitrogen of the soil is rapidly exhausted.

3. Really large crops of turnips can only be obtained when the soil supplies a liberal amount of nitrogenous (and carbonaceous?) matter, as well as mineral constituents; and when they are already available within the soil, or are supplied in the form of farmyard manure, rape-cake, Peruvian guano, ammonia-salts, &c., the rapidity of growth, and the amount of the crop, are greatly increased by the use of superphosphate of lime applied near to the seed.

The land is now devoted to experiments with sugar-beet; for particulars of which see next page.

EXPERIMENTS ON SUGAR BEET—BARN FIELD.
GROWN YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE, COMMENCING 1871.
Previous Cropping:—1843-48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure, 1849-52 (4 Seasons), experiments on Swede Turnips, with different descriptions of Manure, 1853-55 (3 Seasons), Barley without Manure (with a view as far as possible to equalise the condition of the Plots), 1856-70 (15 Seasons), experiments on Swede Turnips, with different descriptions of Manure, in which the arrangement of the Plots was the same, and that of the Manures very similar—in fact, exactly the same during the last 10 years—as in the first year of Sugar Beet, excepting that, during those 10 years, the Alkalies were omitted for the Swedes. For the second and subsequent years of Sugar Beet slight alterations in the Manures were made, as will be seen below.

Area under experiment about 8 acres. The experiments are arranged as under, in 5 Series, each of which comprises 8 Plots.
Manures, per Acre, per Annum.

Plots.	SERIES 1.	SERIES 2.		SERIES 3.		SERIES 4.		SERIES 5.	
		Each Plot as Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.	Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."	Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."	Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."	Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			
FIRST SEASON, 1871.									
PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
1	Farmyard Manure (14 tons)	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.
2	Farmyard Manure (14 tons)	18 3	3 5	27 13	5 6	22 1	6 14	28 18	5 14
3	Without Manure (for 30 years)	14 13	2 14	25 16	5 15	4 6	25 2	25 4	5 5
4	3½ cwt. Superphosphate, 300 lbs. Sulph. Potass., 200 lbs. Sulphate Soda, and 3½ 100 lbs. Sulphate Magnesia	7 11	2 0	22 3	5 12	4 16	7 0	20 16	4 12
5	3½ cwt. Superphosphate, and 300 lbs. Sulph. Potass.	5 12	1 8	20 19	3 14	17 10	3 5	21 7	3 19
6	3½ cwt. Superphosphate, and 300 lbs. Sulph. Potass.	5 18	1 5	21 8	3 13	15 4	3 19	18 19	4 5
7	3½ cwt. Superphosphate, and 300 lbs. Sulph. Potass., and 36½ lbs. Ammonia-salts (?)	5 18	1 5	20 19	3 13	17 4	3 4	21 0	3 11
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	7 10	1 14	21 13	3 16	16 2	4 15	17 19	4 9
SECOND SEASON, 1872.									
PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
1	Farmyard Manure (14 tons)	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.
2	Farmyard Manure (14 tons)	16 3	3 12	22 14	9 0	25 8	3 11	23 10	7 8
3	Without Manure (for 30 years)	16 3	3 12	22 14	9 0	25 8	3 11	23 10	7 8
4	3½ cwt. Superphosphate, 500 lbs. Sulph. Potass., 200 lbs. Chloride Soda, and 200 lbs. Sulphate Magnesia	7 17	1 13	22 4	4 13	16 3	10 1	16 3	3 11
5	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	6 14	1 10	20 2	5 19	15 10	8 7	17 18	3 15
6	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4
7	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10
THIRD SEASON, 1873.									
PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
1	Farmyard Manure (14 tons)	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.
2	Farmyard Manure (14 tons)	15 2	5 12	20 5	10 9	22 2	9 18	22 15	12 10
3	Without Manure (for 30 years)	14 6	5 2	21 0	11 0	19 4	8 9	23 7	13 6
4	3½ cwt. Superphosphate, 500 lbs. Sulph. Potass., 200 lbs. Chloride Soda, and 200 lbs. Sulphate Magnesia	5 2	1 11	14 5	9 3	3 16	15 12	14 13	4 1
5	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	5 5	1 13	16 9	6 11	12 10	3 10	20 3	8 0
6	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	4 12	1 5	18 8	5 13	10 19	5 0	14 15	9 8
7	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass., and 36½ lbs. Ammonia-salts (?)	5 19	1 12	16 14	5 3	12 18	3 12	20 2	9 5
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	4 11	1 7	12 9	5 18	13 0	2 13	19 16	9 0
FOURTH SEASON, 1874.									
PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).									
1	Farmyard Manure (14 tons)	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.	Roots, Tons, cwt.	Leaves, Tons, cwt.
2	Farmyard Manure (14 tons)	15 2	5 12	20 5	10 9	22 2	9 18	22 15	12 10
3	Without Manure (for 30 years)	14 6	5 2	21 0	11 0	19 4	8 9	23 7	13 6
4	3½ cwt. Superphosphate, 500 lbs. Sulph. Potass., 200 lbs. Chloride Soda, and 200 lbs. Sulphate Magnesia	5 2	1 11	14 5	9 3	3 16	15 12	14 13	4 1
5	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	5 5	1 13	16 9	6 11	12 10	3 10	20 3	8 0
6	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass.	4 12	1 5	18 8	5 13	10 19	5 0	14 15	9 8
7	3½ cwt. Superphosphate, and 500 lbs. Sulph. Potass., and 36½ lbs. Ammonia-salts (?)	5 19	1 12	16 14	5 3	12 18	3 12	20 2	9 5
8	Without Manure 1853 and since; previously part Unmanured, and part Superphosphate	4 11	1 7	12 9	5 18	13 0	2 13	19 16	9 0

For the Crop of 1874 Superphosphate of Lime, Sulphate of Potass, Chloride of Soda, and Sulphate of Magnesia, applied as in 1872 and 1873; but no farmyard manure, or cross-dressings of Nitrate of Soda, Ammonia-salts, or Rape-cake.

(*) Superphosphate of Lime "—in all cases made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1.7 (and water).
(*) "Ammonia-salts"—in each case equal parts Sulphate and Murate of Ammonia of Commerce.

AGDELL FIELD.

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 crop (1874) is the 27th experimental one, or the third crop of the Seventh Course. One-third of the land has been continuously unmanured; one-third manured with Superphosphate of Lime alone once every four years, that is for the turnip-crop commencing each course; and one-third manured (also for the turnip-crop only) with a complex manure, as described in the foot-note, No. 2.

In the Second, Third, Fourth, Fifth, and Sixth Courses, instead of clover, half of each plot was sown with beans, and the other half left fallow; for the third crop of the Seventh Course clover was again sown (spring 1873), on half of each plot, the other half being left fallow.

From half of each of the three plots the whole turnip-crop (roots and leaves) was removed; and on the other half the roots were eaten on the land by sheep, and the uneaten leaves spread and ploughed in. In the case of all the other crops, the total produce was removed from the land.

The abstract of the results given below relates to the portions of each plot from which the turnip-crops were entirely removed; and on which, in the second, third, fourth, fifth, and sixth courses, beans (not fallow) replaced the clover.

(Area under experiment, about 2½ acres.)

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.	PRODUCE PER ACRE.								
		Plot 1. Unmanured continuously.			Plot 2. Superphosphate of Lime, ¹ alone, for the Turnip Crops only.			Plot 3. Complex Manure, ² for the Turnip Crops only.		
		Corn ³ (or Roots).	Straw (or Leaf).	Total Produce. ⁴	Corn ³ (or Roots).	Straw (or Leaf).	Total Produce. ⁴	Corn ³ (or Roots).	Straw (or Leaf).	Total Produce. ⁴
1ST COURSE, 1848-51.										
1848	Norfolk White Turnips	65½ cwt.	45½ cwt.	111½ cwt.	22½ cwt.	10½ cwt.	33½ cwt.	218 cwt.	151½ cwt.	369½ cwt.
1849	Barley	44½ bush.	2983 lbs.	5656 lbs.	29½ bush.	2111 lbs.	3841 lbs.	26½ bush.	2088 lbs.	3794 lbs.
1850	Clover (calc. as hay)	..	..	54 cwt.	..	..	5½ cwt.	..	..	63 cwt.
1851	Wheat	28½ bush.	3431 lbs.	5389 lbs.	28 bush.	3371 lbs.	5253 lbs.	28½ bush.	3553 lbs.	5500 lbs.
2ND COURSE, 1852-55.										
1852	Swedish Turnips	56 cwt.	44 cwt.	304 cwt.	22½ cwt.	204 cwt.	243½ cwt.	397½ cwt.	361 cwt.	433 cwt.
1853	Barley	343 bush.	2430 lbs.	4465 lbs.	284 bush.	1873 lbs.	3560 lbs.	38½ bush.	2804 lbs.	4573 lbs.
1854	Beans	5½ bush.	1055 lbs.	1445 lbs.	5½ bush.	1103 lbs.	1534 lbs.	3½ bush.	1355 lbs.	2065 lbs.
1855	Wheat	35½ bush.	3619 lbs.	5839 lbs.	35½ bush.	3595 lbs.	5789 lbs.	37½ bush.	3942 lbs.	6371 lbs.
3RD COURSE, 1856-59.										
1856	Swedish Turnips	32 cwt.	2½ cwt.	34½ cwt.	136 cwt.	7½ cwt.	143½ cwt.	333½ cwt.	124 cwt.	346½ cwt.
1857	Barley	48½ bush.	2600 lbs.	5337 lbs.	284 bush.	1475 lbs.	3076 lbs.	48 bush.	2435 lbs.	7391 lbs.
1858	Beans	6½ bush.	1100 lbs.	1515 lbs.	6½ bush.	1185 lbs.	1605 lbs.	12½ bush.	1320 lbs.	2357 lbs.
1859	Wheat	35½ bush.	4030 lbs.	6262 lbs.	34½ bush.	3890 lbs.	6120 lbs.	39½ bush.	4610 lbs.	7154 lbs.
4TH COURSE, 1860-63.										
1860	Swedish Turnips	1 cwt.	(6½ lbs.)	1 cwt.	294 cwt.	1½ cwt.	304 cwt.	87½ cwt.	34 cwt.	904 cwt.
1861	Barley	32½ bush.	2322 lbs.	4718 lbs.	30½ bush.	2000 lbs.	3775 lbs.	60½ bush.	3940 lbs.	7391 lbs.
1862	Beans	29 bush.	1840 lbs.	3661 lbs.	29½ bush.	2150 lbs.	4040 lbs.	43½ bush.	3280 lbs.	5990 lbs.
1863	Wheat	44½ bush.	3437 lbs.	6330 lbs.	34½ bush.	3890 lbs.	5119 lbs.	46½ bush.	4597 lbs.	7626 lbs.
5TH COURSE, 1864-67.										
1864	Swedish Turnips	8½ cwt.	6½ cwt.	94 cwt.	68 cwt.	44 cwt.	72½ cwt.	176½ cwt.	8½ cwt.	185 cwt.
1865	Barley	39 bush.	2174 lbs.	4182 lbs.	334 bush.	1615 lbs.	3394 lbs.	47½ bush.	2535 lbs.	5148 lbs.
1866	Beans	10½ bush.	1013 lbs.	1629 lbs.	7½ bush.	978 lbs.	1463 lbs.	20½ bush.	1990 lbs.	3343 lbs.
1867	Wheat	21 bush.	2143 lbs.	3473 lbs.	19½ bush.	1966 lbs.	3222 lbs.	22½ bush.	3003 lbs.	4567 lbs.
6TH COURSE, 1868-71.										
1868	Swedish Turnips	Failed, and ploughed up.			Failed, and ploughed up.			Failed, and ploughed up.		
1869	Barley	24½ bush.	1948 lbs.	3358 lbs.	28½ bush.	2025 lbs.	3686 lbs.	42½ bush.	3309 lbs.	5800 lbs.
1870	Beans	13½ bush.	738 lbs.	1591 lbs.	15½ bush.	768 lbs.	1778 lbs.	24½ bush.	1056 lbs.	2664 lbs.
1871	Wheat	20½ bush.	2793 lbs.	4092 lbs.	23½ bush.	3048 lbs.	4521 lbs.	23 bush.	3440 lbs.	4883 lbs.
7TH COURSE, 1872-75.										
1872	Swedish Turnips	34½ cwt.	84 cwt.	42½ cwt.	170½ cwt.	17½ cwt.	188 cwt.	339½ cwt.	85½ cwt.	375½ cwt.
1873	Barley	28½ bush.	1343 lbs.	2717 lbs.	20½ bush.	1565 lbs.	2875 lbs.	31½ bush.	1723 lbs.	3573 lbs.
1874	Clover	..	..	..	..	..	..	..	..	..
1875	Wheat	..	..	..	..	..	..	..	..	..

SUMMARY—AVERAGE OF THE FIRST 6 COURSES, 1848-1871.

1848, '52, '56, '60, '64	Swedish Turnips	26½ cwt.	10½ cwt.	37½ cwt.	136½ cwt.	28 cwt.	164½ cwt.	242½ cwt.	4½ cwt.	255 cwt.
1849, '53, '57, '61, '65, '69	Barley	38½ bush.	2440 lbs.	4619 lbs.	20 bush.	1850 lbs.	3553 lbs.	44½ bush.	2829 lbs.	5362 lbs.
1850, '54, '58, '62, '66, '70	Clover, 1850 (calc. as hay)	..	..	54 cwt.	..	..	57½ cwt.	..	..	63 cwt.
1851, '55, '59, '63, '67, '71	Wheat	30½ bush.	3248 lbs.	6238 lbs.	29½ bush.	3205 lbs.	5087 lbs.	33½ bush.	3874 lbs.	6017 lbs.

(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, and Seventh Courses—200 lbs. Bone-ash, and 150 lbs. Sulphuric Acid, per acre.

(2) 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 Potass, 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, and Seventh Courses—320 lbs. Sulphate of Potass, 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.

(3) The quantities given in Bushels represent the Dressed Corn only.

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

EXPERIMENTS WITH DIFFERENT DESCRIPTIONS OF WHEAT, IN 1874, AND SUMMARY OF RESULTS OBTAINED IN PREVIOUS YEARS.

Season 1874. UPPER HARPENDEN FIELD. 2 Cwts. Nitrate Soda; after Mangolds with Dung 1873, Carried off.	DRESSED CORN PER ACRE.										WEIGHT PER BUSHEL.					
	1868;	1869;	1870;	1871;	1872;	1873;	Average.	1868;	1869;	1870;	1871;	1872;	1873;	Average.		
	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	Bushels.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.		
1. White-chaff (Red) ... ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	40½	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	58½
2. Rivett's (Red) ... ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	48½	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	57½
3. Chubb Wheat (Red) ... ..	.. ..	.. ..	.. ..	28½	.. ..	.. ..	35½	.. ..	.. ..	.. ..	60½	61½	59½	60½
4. Red-chaff (White) ... ..	.. ..	.. ..	.. ..	32½	.. ..	.. ..	35	.. ..	.. ..	.. ..	61½	62½	60½	61½
5. Browick (Red) ... ..	.. ..	.. ..	50½	38½	.. ..	.. ..	41½	.. ..	.. ..	64½	60	61½	59½	61½
6. Red Wonder	51½	54½	51	31½	43½	37½	45	63	60½	64½	59	60	60	61½		
7. Burwell (Old Red Lammas) ...	41½	48½	48½	31½	41½	35½	41	64	63	65½	62	63	61½	63½		
8. Bristol Red ... ..	.. ..	54½	50	29½	44½	39½	43½	66	61	65½	60½	61½	60½	61½	
9. Red Nursey	41½	49½	45	34½	45½	27½	40½	66	65	67½	63	65	62	64½		
10. Red Langham ... ..	.. ..	53	49½	30½	43½	34½	42½	.. ..	61	65½	60½	61½	60½	61½
11. Woolly Bar (White)	44½	52½	47½	31½	42½	37	42½	64	61½	64½	61½	62½	61½	62½		
12. Hardselle (White) ... ..	.. ..	.. ..	.. ..	.. ..	46½	42	44½	.. ..	.. ..	.. ..	.. ..	61½	59½	60½
13. Golden Drop (Red), Hallett's	.. ..	.. ..	.. ..	39½	49½	44½	44½	.. ..	.. ..	.. ..	61½	63	59½	61½
14. Victoria White, Hallett's	.. ..	.. ..	.. ..	38½	45½	38½	39½	.. ..	.. ..	.. ..	61	62½	59½	61½
15. Hunter's White, Hallett's	.. ..	.. ..	.. ..	26½	39½	38½	35½	.. ..	.. ..	.. ..	59½	61½	57½	59½
16. Original Red, Hallett's	.. ..	.. ..	.. ..	30	35½	36½	33½	.. ..	.. ..	.. ..	58½	60	56½	58½
17. White Chiddam	49	49½	45½	26½	38½	31½	40½	64½	60½	66½	62½	63	59½	62½		
18. Red Rostock	46½	51½	.. ..	37	46½	45½	45½	65½	61½	.. ..	60½	.. ..	56½	60½
19. Casey's White	.. ..	.. ..	50½	29½	42½	37½	40	.. ..	.. ..	64½	60½	61½	58½	61½
20. Golden Rough-chaff (Red)	.. ..	.. ..	.. ..	33	39½	38½	36½	.. ..	.. ..	.. ..	61½	62½	59½	61½
21. Bolé's Prolife (Red)	.. ..	.. ..	53½	38½	42½	45½	43½	.. ..	.. ..	65½	61½	62½	57½	61½
22. Club Wheat (Red)	.. ..	.. ..	.. ..	36	45½	47½	48½	.. ..	.. ..	.. ..	60½	61½	58½	60½
23. Niagara (Red)	.. ..	48½	48½	.. ..	.. ..	.. ..	45½	.. ..	60½	65	.. ..	.. ..	.. ..	63½
24. Clover's Suffolk Red	41½	.. ..	.. ..	.. ..	.. ..	.. ..	41½	64	.. ..	.. ..	.. ..	.. ..	.. ..	64
25. Golden Drop (Red)	.. ..	50½	50½	35½	.. ..	.. ..	45½	.. ..	62½	66	61½	.. ..	.. ..	63½
26. Maynard's (Red)	.. ..	.. ..	.. ..	31½	.. ..	.. ..	31½	.. ..	.. ..	.. ..	61½	.. ..	.. ..	61½
Mean	45½	50½	49½	32½	42½	38½	41	64½	61½	65½	60½	62½	59½	61½		

EXPERIMENTS WITH A VIEW TO ECONOMY IN THE USE OF EXPENSIVE NITROGENOUS MANURES.

It is found that generally less than half the nitrogen supplied in such manures as guano, ammonia-salts, or nitrate of soda, is recovered in the increase of the crop for which they are used; that a considerable quantity may remain in the soil in a comparatively inactive state, yielding increase very slowly; and that a considerable quantity may be carried away by drainage, and lost. It seemed desirable, therefore, to commence a series of

experiments to determine whether any saving can be effected by applying comparatively small quantities near to the seed, instead of larger amounts in the usual mode of broadcast sowing and harrowing-in.

It is also intended to make experiments with a view to ascertain the best periods of the year for the application of such manures to different crops.

FIRST SEASON, 1871.—Experiments upon Wheat. Little Hoos Field. Plots $\frac{1}{4}$ acre each.

PLOT No.	MANURES PER ACRE, &c.	PRODUCE PER ACRE.		
		Dressed Corn,		Total Straw.
		Quantity.	Weight per Bushel.	
Bushels.	lbs.	cwts.		
1	Unmanured. Seed 1 bushel, dibbled 6 inches apart in the rows	23 $\frac{3}{4}$	59.3	24 $\frac{1}{2}$
2	{146 lbs. Sulphate Ammonia (containing Nitrogen = 15 bushels grain, and its straw). Seed 1 bushel; .. } {Holes dibbled 6 inches apart in the rows; manure (mixed with Ashes) put in, and seed above }	31 $\frac{1}{2}$	59.1	36 $\frac{1}{2}$
3	{292 lbs. Sulphate Ammonia. Seed 1 bushel; } {Manure (mixed with Ashes) sown broadcast, seed dibbled 6 inches apart in the rows }	28 $\frac{3}{4}$	58.3	35 $\frac{1}{2}$

FIRST SEASON, 1871.—Experiments upon Barley. Thirty-acres Field. Plots $\frac{1}{2}$ acre each.

PLOT No.	MANURES PER ACRE, &c.	Bushels.	lbs.	cwts.
		1	Unmanured. Seed 3 bushels; drilled	40 $\frac{3}{4}$	53.9	24$\frac{3}{4}$
2	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; } {Manures mixed with Ashes and sown broadcast; seed drilled }	49 $\frac{1}{2}$	53.3	30 $\frac{1}{2}$
3	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; .. } {Manures mixed with Ashes and drilled; seed drilled above }	49 $\frac{1}{2}$	53.4	28 $\frac{1}{2}$
4	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 3 bushels; } {Manures, Ashes, and Seed mixed, and drilled together }	51	53.0	30 $\frac{1}{2}$
5	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 1 $\frac{1}{2}$ bushel; .. } {Holes dibbled, 6 inches apart in the rows; Manures (mixed with Ashes) put in, and Seed above } }	51 $\frac{1}{2}$	53.3	28 $\frac{1}{2}$
6	{2 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 3 bushels; } {Manures mixed with Ashes and sown broadcast; seed drilled }	56 $\frac{1}{4}$	51.6	32 $\frac{1}{2}$

SECOND SEASON, 1872.—Experiments upon Barley. Thirty-acres Field. Plots $\frac{1}{2}$ acre each.

PLOT No.	MANURES PER ACRE, &c.	Bushels.	lbs.	cwts.
		1	Unmanured. Seed 2 $\frac{1}{2}$ bushels, drilled	33 $\frac{1}{2}$
2	{3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2 $\frac{1}{2}$ bushels; .. } {Manures made up to 15 bushels per acre with Ashes, and sown broadcast; seed drilled }	46 $\frac{1}{2}$	54.1	30 $\frac{1}{2}$
3	{3 cwts. Superphosphate, 2 cwts. Nitrate Soda. Seed 2 $\frac{1}{2}$ bushels; .. } {The Superphosphate mixed with 40 lbs. slaked Lime to neutralize the acid, the Nitrate added, and the whole made up to 15 bushels per acre with Ashes, and sown broadcast; Seed drilled }	47 $\frac{1}{2}$	53.6	31 $\frac{1}{2}$
4	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2 $\frac{1}{2}$ bushels; .. } {Manures and Seed made up to 15 bushels per acre with Ashes, and the whole (Manure, Seed, and Ashes) drilled together }	42 $\frac{3}{4}$	54.1	26 $\frac{1}{2}$
5	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda. Seed 2 $\frac{1}{2}$ bushels; .. } {Manures and Seed made up to 15 bushels per acre with a mixture of half Lime and half Ashes, and the whole (Manure, Seed, Lime, and Ashes) drilled together }	43 $\frac{1}{2}$	53.1	27

THIRD SEASON, 1873.

Some experiments were conducted in which a given quantity of Nitrate of Soda (generally at the rate of 1 cwt. per acre) was, by means of plaster of Paris, and other substances, made to adhere to the seed, forming a coating upon it. Experiments in pots, well watered and kept in a greenhouse, showed that barley so coated germinated well, and gave strong and healthy plants; but owing to the wetness of the weather previously, to the consequent lateness of sowing, and to the scarcity of rain afterwards, the coated seeds sown in the field came up so irregularly, that it was considered not worth while to keep the crop separate at harvest. Even if it had not been so, there are practical difficulties in the way of so preparing the seed, which might render the method inapplicable in ordinary practice.

FOURTH SEASON, 1874.—Experiments upon Barley. Barn Field. Plots $\frac{1}{4}$ acre each.

PLOT No.	MANURES PER ACRE, &c.	PRODUCE PER ACRE.		
		Dressed Corn,		Total Straw.
		Quantity.	Weight per Bushel.	
Bushels.	lbs.	cwts.		
1	Unmanured. Seed 2 bushels, dibbled 6 inches apart in the rows			
2	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 2 cwts. Ashes; Seed 2 bushels; .. } {All mixed, made into a paste with water, and dibbled 6 inches apart in the rows }			
3	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 80 lbs. slaked Lime; Seed 2 bushels } {All mixed, and dibbled 6 inches apart in the rows }			
4	{1 cwt. Superphosphate, 1 cwt. Nitrate Soda, 2 cwts. Ashes; Seed 2 bushels; .. } {Manures mixed and sown broadcast; Seed drilled }			