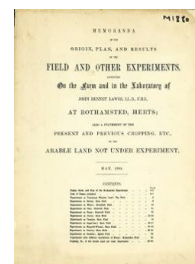


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M E M O R A N D A

OF THE

O R I G I N, P L A N, A N D R E S U L T S

OF THE

F I E L D A N D O T H E R E X P E R I M E N T S,

C O N D U C T E D

On the Farm and in the Laboratory of

JOHN BENNET LAWES, LL.D., F.R.S.,

A T R O T H A M S T E D, H E R T S;

A L S O A S T A T E M E N T O F T H E

P R E S E N T A N D P R E V I O U S C R O P P I N G, E T C.,

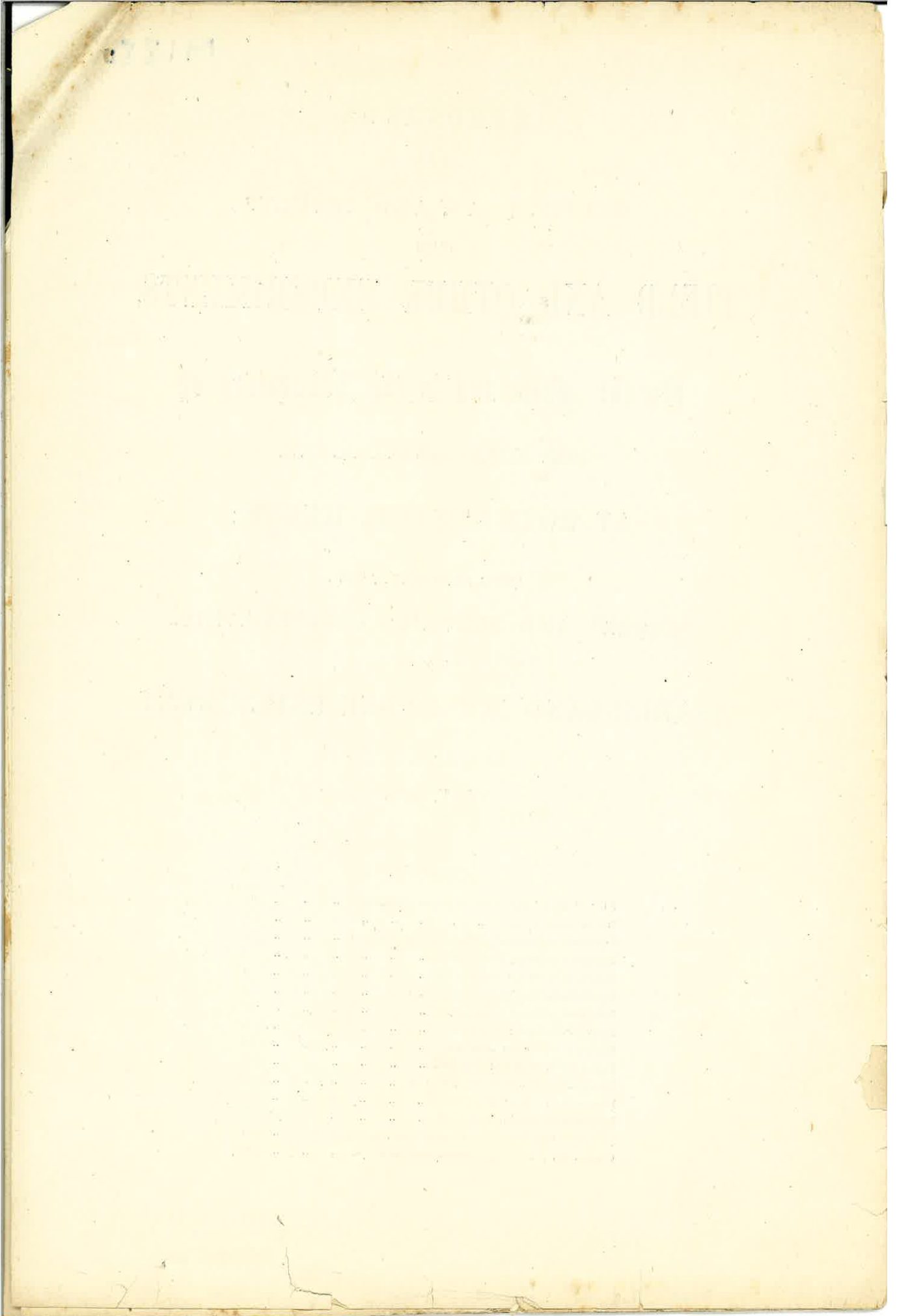
O F T H E

A R A B L E L A N D N O T U N D E R E X P E R I M E N T.

M A Y, 1880.

C O N T E N T S.

	P A G E
Origin, Scope, and Plan of the Rothamsted Experiments	3-5
Lists of Papers published	6-7
Experiments on Permanent Meadow Land; The Park	8
Experiments on Barley; Hoos Field	9
Experiments on Wheat; Broadbalk Field	10
Experiments on Oats; Geescroft Field	11
Experiments on Beans; Geescroft Field	12
Experiments on Clover; Hoos Field	13-14
Experiments on Turnips; Barn Field	15
Experiments on Sugar-beet; Barn Field	16-17
Experiments on Mangold-Wurzel; Barn Field	18-19
Experiments on Potatos; Hoos Field	20-21
Experiments on Rotation; Agdell Field	22
Experiments with different descriptions of Wheat; Harpenden Field	23
Cropping, &c., of the Arable Land not under Experiment	24-25



ORIGIN, SCOPE, AND PLAN,
OF THE
ROTHAMSTED EXPERIMENTS.

The following statement of the origin, scope, and plan, of the Rothamsted Investigations, was drawn up in answer to a circular letter issued by a Committee appointed to arrange for the commemoration of the twenty-fifth anniversary of the establishment of the First Experimental Station in Germany (Möckern), which was held in Leipzig in September 1877. The precise form of the statement depended on the order and form of the questions to which it is an answer. It has already been published in German, almost in full, with the series of reports of other Experimental Stations, which was issued at the time of the Jubilee Meeting.¹ It has been thought that it would be of some interest as an introduction to the *Memoranda of the Plan and Results of the Field Experiments, &c.*, annually issued at Rothamsted, and which here follow it. To the general statement, which, with a few slight alterations correcting it up to date, is given in the form in which it was originally drawn up, are appended lists of the titles of all the papers already published, with full reference to the Journals in which they appeared.

Mr. Lawes was the founder of the Rothamsted Experimental Station. He commenced experiments with different manuring substances, first with plants in pots, and afterwards in the field, soon after entering into possession of his hereditary property at Rothamsted² in 1834. The researches of De Saussure on vegetation were the chief subjects of his study to this end. Of all the experiments so made, those in which the neutral phosphate of lime, in bones, bone-ash, and apatite, was rendered soluble by means of sulphuric acid, and the mixture applied for root-crops, gave the most striking results. The results obtained on a small scale in 1837, 1838, and 1839, were such as to lead to more extensive trials in the field in 1840 and 1841, and subsequently.

In 1843 more systematic field experiments were commenced; and a barn, which had previously been partially applied to laboratory purposes, became almost exclusively devoted to agricultural investigations. The foundation of the Rothamsted Experimental Station may be said to date from that time (1843).

The Rothamsted station has up to the present time been entirely disconnected from any external organization, and has been maintained entirely by Mr. Lawes. He has further set apart a sum of £100,000, and certain areas of land, for the continuance of the investigations after his death.

In 1854-5 a new laboratory was built, by public subscription of agriculturists, and presented to Mr. Lawes, in July 1855, from which date the old barn-laboratory was abandoned, and the new one has been occupied.

From June 1843, up to the present time, Dr. J. H. Gilbert has been associated with Mr. Lawes, and has had the direction of the laboratory.

The number of assistants and other helps has increased from time to time. At first only one laboratory man was employed; but very soon a chemical assistant was necessary, and next a computer and record-keeper.

During the last twenty-five years the staff has consisted of—
One or two, and sometimes three, chemists.

Two or three general assistants. One of these is usually employed in routine chemical work, but sometimes in more general work. The chief occupation of the general assistants is to superintend the field experiments—that is, the making of the manures, the measurement of the plots, the application of the

manures, and the harvesting of the crops; also the taking of samples, the preparation of them for preservation or analysis, and the determinations of dry matter, ash, &c. These assistants also superintend any experiments made with animals. There are now more than 25,000 bottles of samples of experimentally-grown vegetable produce, of animal products, of ashes, or of soils, stored in the laboratory.

A botanical assistant is also occasionally employed, with from three to six boys under him, and with him is generally associated one of the permanent general assistants, who at other times undertakes the botanical work.

Two or three (for some time past three) computers and record-keepers have been occupied in calculating and tabulating field, feeding, and laboratory results, copying, &c.

One, and sometimes two, laboratory men are employed.

Besides the permanent laboratory staff, chemical assistance is frequently engaged in London, or elsewhere; and, in this way, for some years past, Mr. R. Richter, of Berlin, has been almost constantly occupied with analytical work sent from Rothamsted.

The field experiments, and occasionally feeding experiments, also employ a considerable but a very variable number of agricultural labourers.

Nothing has been done at Rothamsted in the way of manure-, feeding-stuff-, or seed-control.

The investigations may be classed under two heads:—

I.—FIELD EXPERIMENTS, EXPERIMENTS ON
VEGETATION, &c.

The general scope and plan of the field experiments has been:—

To grow some of the most important crops of rotation, each separately, year after year, for many years in succession on the same land, without manure, with farmyard-manure, and with a great variety of chemical manures; the same description of manure being, as a rule, applied year after year on the same plot. Experiments on an actual course of rotation, with different manures, have also been made. In this way field experiments have been conducted as follows:—

(1) Die landwirthschaftlichen Versuchs-Stationen. Band xxii. 1877.

(2) Rothamsted is in Hertfordshire, twenty-five miles from London, on the Midland Railway; station, Harpenden.

On Wheat, thirty-seven years in succession; 13 acres, 35 plots, many of which are duplicates of others.

On Barley, twenty-nine years in succession; $4\frac{1}{2}$ acres, 23 (or 29) plots.

On Oats, ten years (including one year fallow); $\frac{3}{4}$ acre, 6 plots.

On Wheat, alternated with fallow, twenty-nine years; 1 acre, 2 plots.

On different descriptions of Wheat, thirteen years; 4-8 acres (each year in a different field), now more than 20 plots.

On Beans, thirty-two years (including one year Wheat and five years fallow); $1\frac{1}{4}$ acre, 10 plots. Also twenty-seven years; 5 plots, 1 acre.

On Beans, alternated with Wheat, twenty-eight years; 1 acre 10 plots.

On Clover, with fallow or a corn-crop intervening, twenty-six years; 3 acres, 18 plots. The land afterwards devoted to experiments with various Leguminous plants.

On Turnips, twenty-eight years (including three years' barley); about 8 acres, 40 plots.

On Sugar Beet, five years; about 8 acres, 40 plots.

On Mangel Wurzel, five years (in progress); about 8 acres, 40 plots.

On Potatos, five years (in progress); 2 acres, 10 plots.

On Rotation, thirty-three years; about $2\frac{1}{2}$ acres, 12 plots.

On permanent Grass-land, twenty-five years; about 7 acres, 22 plots.

Comparative experiments with different manures have also been made on other descriptions of soil, in other localities.

Samples of all the experimental crops are taken, and brought to the laboratory. Weighed portions of each are partially dried, and preserved for future reference or analysis. Duplicate weighed portions of each are dried at 100° C., the dry matter determined, and then burnt to ash on platinum sheets in cast-iron muffles. The quantities of ash are determined and recorded, and the ashes themselves are preserved for reference, or analysis.

In a large proportion of the samples the nitrogen is determined; and in some the amount existing as albuminoids.

In selected cases, illustrating the influence of season, manures, exhaustion, &c., complete ash-analyses have been made, numbering in all more than 600.

Also in selected cases, illustrating the influence of season and manuring, quantities of the experimentally-grown Wheat grain have been sent to the mill, and the proportion and composition of the different mill-products determined.

In the Sugar Beet, Mangel Wurzel, and Potatos, the sugar in the juice has in most cases been determined by polariscope, and frequently by copper also.

In the case of the experiments on the mixed herbage of permanent grass land, besides the samples taken for the determination of chemical composition (dry matter, ash, nitrogen, woody fibre, fatty matter, and composition of ash), carefully averaged samples have frequently been taken for the determination of the botanical composition. In this way, on four occasions, at intervals of five years—viz., in 1862, 1867, 1872, and 1877—a sample of the produce of each plot was taken, and submitted to careful botanical separation, and the percentage, by weight, of each species in the mixed herbage determined. Partial separations have also been made in other years.

INVESTIGATION OF SOILS.

Samples of the soils of most of the experimental plots have been taken from time to time, generally to the depth of 9, 18, and 27 inches, but sometimes to twice this depth. In this way about 600 samples have been taken, submitted to partial mechanical separation, and portions of the mould have been care-

fully prepared and preserved for analysis. In a large proportion of the samples the loss on drying at different temperatures, and at ignition, has been determined. In most the nitrogen determinable by burning with soda-lime has been estimated. In some the carbon, and in some the nitrogen as nitric acid, have been determined. Some experiments have also been made on the comparative absorptive capacity (for water and ammonia) of different soils and subsoils. The systematic investigation of the amount, and condition, of the nitrogen, and of some of the more important mineral constituents, of the soils of the different plots, and from different depths, is now in progress or contemplated.

RAINFALL AND DRAINAGE.

Almost from the commencement of the experiments the rainfall has been measured—for twenty-seven years in a gauge of one-thousandth of an acre area, as well as in an ordinary small funnel-gauge of 5 inches diameter. From time to time the nitrogen, as ammonia and as nitric acid, has been determined in the rain waters. The chlorine has, also, in some cases been determined.

Three "drain gauges," also of one-thousandth of an acre each, for the determination of the quantity and composition of the water percolating respectively through 20 inches, 40 inches, and 60 inches depth of soil (with its subsoil in natural state of consolidation) have also been constructed. A more numerous series of smaller "drain gauges," arranged for the investigation of the influence of different crops, and of different manures, has been constructed; but they have been found to be not sufficiently water-tight. Each of the differently manured plots of the permanent experimental Wheat-field having a separate pipe-drain, the drainage-waters have been and are frequently collected and analysed.

Professor Frankland has determined the nitrogen, as ammonia, as nitric acid, and as organic nitrogen, and also some other constituents, in many samples both of the rain and of the various drainage waters collected at Rothamsted. Dr. Voelcker also has determined the combined nitrogen, and likewise the incombustible constituents, in many of the drainage waters.

The nitrogen existing as nitric acid, sometimes that in other forms, and also some other constituents, are, and for some time past have been, determined periodically, in both the rain and the various drainage waters.

AMOUNT OF WATER TRANSPIRED BY PLANTS.

For several years in succession, experiments were made to determine the amount of water given off by plants during their growth. In this way various plants, including representatives of the gramineous, the leguminous, and other families, have been experimented upon. Similar experiments have also been made with various trees.

BOTANICAL CHARACTERISTICS, &c.

Having regard to the difference in the character and amount of the constituents assimilated by plants of different botanical relationships, under equal external conditions, or by the same description of plants, under varying conditions, observations have been made on the character and range of the roots of different plants, and on their relative development of stem, leaf, &c. In the case of various crops, but more especially with Wheat and Beans, samples have been taken at different stages of growth, and the composition determined, in more or less detail, sometimes of the entire plant, and sometimes of the separated parts. In a few cases the amounts of dry matter, ash, nitrogen, &c., in the above-ground growth of a given area, at different stages of development, have been determined. The amounts of stubble of different crops have also occasionally been estimated.

ASSIMILATION OF FREE NITROGEN.

Experiments were made for several years in succession to determine whether plants assimilate free or uncombined nitrogen, and also various collateral points. Plants of the gramineous, the leguminous, and of other families were operated upon. The late Dr. Pugh took a prominent part in this inquiry.

II.—EXPERIMENTS ON ANIMALS, ETC.

Experiments with the animals of the farm were commenced early in 1847, and have been continued, at intervals, up to the present time.

The following points have been investigated:—

1. The amount of food, and of its several constituents, consumed in relation to a given live weight of animal within a given time.
2. The amount of food, and of its several constituents, consumed to produce a given amount of increase in live weight.
3. The proportion, and relative development, of the different organs or parts of different animals.
4. The proximate and ultimate composition of the animals in different conditions as to age and fatness, and the probable composition of their increase in live weight during the fattening process.
5. The composition of the solid and liquid excreta (the manure) in relation to that of the food consumed.
6. The loss or expenditure of constituents by respiration and the cutaneous exhalations—that is, in the mere sustenance of living meat-and-manure-making machine.

The general plan of experimenting was as follows:—

To provide data as to the amount of food, or its several constituents, consumed in relation to a given live weight of animal within a given time, and to produce a given amount of increase in live weight, several hundred animals—oxen, sheep, and pigs—have been experimented upon. Selected lots of animals were supplied, for many weeks, or for months consecutively, with weighed quantities of foods, selected and allotted according to the special point under inquiry. The composition of the foods was determined by analysis. The weights of the animals were taken at the commencement, at intervals during the progress, and at the conclusion of the experiment.

The amount, and relative development, of the different organs and parts were determined in two calves, two heifers, fourteen bullocks, one lamb, 249 sheep, and fifty-nine pigs.

The percentage of water, mineral matter, fat, and nitrogenous substance, were determined in certain separated parts, and in the entire bodies, of ten animals—namely, one calf, two oxen one lamb, four sheep, and two pigs. Complete analyses of the ashes, respectively, of the entire carcasses, of the mixed internal and other offal parts, and of the entire bodies, of each of these ten animals have also been made.

From the data provided, as just described, as to the chemical composition of the different descriptions of animal, in different conditions as to age and fatness, the composition of the increase whilst fattening, and the relation of the constituents stored up in increase to those consumed in food, have been estimated.

To ascertain the composition of the manure in relation to that of the food consumed, oxen, sheep, and pigs have been experimented upon.

In the case of oxen, the food and litter (sometimes with an acid absorbent), were weighed, sampled, and analysed; the

animals were fed in boxes, for periods of from five to nine weeks, and the total dung produced was well mixed, weighed, sampled, and analysed. The constituents determined in the food and litter on the one hand, and in the dung on the other, were dry matter, ash, and nitrogen.

In the case of sheep no litter was used; the animals were kept in lots of five, on rafters, through which (but with some little loss) the solid and liquid excreta passed on to a sheet-zinc flooring at such an incline that the liquid drained off at once into carboys containing acid, and the solid matter was removed two or three times daily, and also mixed with acid. The constituents determined in the food and manure were dry matter, mineral matter, sometimes woody fibre, and nitrogen.

In the case of pigs, individual male animals were experimented upon, each for periods of three, five, or ten days only. Each animal was kept in a frame, preventing it from turning round, and having a zinc bottom, with an outlet for the liquid to run into a bottle, and it was watched night and day, and the voidings carefully collected as soon as passed, which could easily be done, as the animal never passed either feces or urine without getting up, and in getting up he rang a bell, and so attracted the notice of the attendant. The constituents determined were, in the food and feces, dry matter, ash and nitrogen, and in the urine, dry matter, ash, nitrogen, and urea.

The loss or expenditure of constituents, by respiration and the cutaneous exhalations, has not been determined directly, that is by means of a respiration-apparatus, but only by difference, that is, by calculation, founded on the amounts of dry matter, ash, and nitrogen, in the food, and in the (increase) feces, and urine.

Independently of the points of inquiry above enumerated, the results obtained have supplied data for the consideration of the following questions:—

1. The characteristic demands of the animal body (for nitrogenous or non-nitrogenous constituents of food) in the exercise of muscular power.
2. The sources in the food of the fat produced in the animal body.
3. The comparative characters of animal and vegetable food in human dietaries.

SUPPLEMENTARY INVESTIGATIONS.

In conjunction with Professor Way, an extensive investigation was undertaken on the application of town sewage to different crops, but especially to grass. The amount, and the composition, of both the sewage and the produce grown were determined; and, in selected cases, the composition of the land drainage-water was also determined. Comparative experiments were also made on the feeding qualities of the differently grown produce; the amount of increase yielded by oxen, and the amount and composition of the milk yielded by cows, being determined. In this inquiry part of the analytical work was performed at Rothamsted, but most of it by Professor Way in London.

The chemistry of the malting process, the loss of food constituents during its progress, and the comparative feeding value of barley and malt, have been investigated.

Although many of the results of the investigations above enumerated have already been published, a large proportion as yet remains unpublished.

The following lists give the titles of the papers already published, arranged in two series, and within each series arranged in chronological order; and they show in what Journal each paper appeared.

SERIES I.—REPORTS OF FIELD EXPERIMENTS, EXPERIMENTS ON VEGETATION, &c.
PUBLISHED 1847—1880, INCLUSIVE.

1. Agricultural Chemistry (Jour. Roy. Ag. Soc. Eng., vol. viii., p. 226) 1847
2. Agricultural Chemistry, Turnip Culture (Jour. Roy. Ag. Soc. Eng., vol. viii., p. 494) 1847
3. Experimental Investigation into the Amount of Water Given Off by Plants during their Growth, especially in relation to the Fixation and Source of their various Constituents (Jour. Hort. Soc. Lond., vol. v., p. 38) 1850
4. Report of some Experiments undertaken at the suggestion of Professor Lindley, to ascertain the Comparative Evaporating Properties of Evergreen and Deciduous Trees (Jour. Hort. Soc. Lond., vol. vi., p. 227) 1851
5. Agricultural Chemistry, especially in relation to the Mineral Theory of Baron Liebig (Jour. Roy. Ag. Soc. Eng., vol. xii., p. 1) 1851
6. On the Amounts of, and Methods of Estimating, Ammonia and Nitric Acid in Rain-water (Report of the British Association for the Advancement of Science for 1854) 1854
7. Report of the Right Hon. the Earl of Leicester, on the Experiments, conducted by Mr. Keary, on the Growth of Wheat upon the same land for four successive years, at Holkham Park Farm (Jour. Roy. Ag. Soc. Eng., vol. xvi., p. 207) 1855
8. On some points connected with Agricultural Chemistry; being a reply to Baron Liebig's "Principles of Agricultural Chemistry" (Jour. Roy. Ag. Soc. Eng., vol. xvi., p. 411) 1855
9. On the Growth of Wheat by the Lois Weedon System, on the Rothamsted Soil; and on the Combined Nitrogen in Soils (Jour. Roy. Ag. Soc. Eng., vol. xvii., p. 582) 1856
10. On some points in the Composition of Wheat Grain, its Products in the Mill, and Bread (Journal of the Chemical Society of London, vol. x., p. 1) .. 1857
11. On the Growth of Barley by Different Manures continuously on the Same Land; and on the Position of the Crop in Rotation (Jour. Roy. Ag. Soc. Eng., vol. xviii., p. 454) 1857
12. Report of Experiments with different Manures on Permanent Meadow Land, with Tabular Appendix (Jour. Roy. Ag. Soc. Eng., vols. xix., p. 552, and xx., pp. 228 and 398) 1858-9
13. Report of Experiments on the Growth of Red Clover by different Manures (Jour. Roy. Ag. Soc. Eng., vol. xxi., p. 178) 1860
14. On the Sources of the Nitrogen of Vegetation; with special reference to the question whether Plants Assimilate Free or Uncombined Nitrogen.—Abstract (Proceedings of the Royal Society of London, vol. x., p. 544) 1860
15. On the Application of Different Manures to Different Crops, and on their Proper Distribution on the Farm 1861
16. On some Points in connection with the Exhaustion of Soils.—Abstract (Report of the British Association for the Advancement of Science for 1861) .. 1861
17. On the Sources of the Nitrogen of Vegetation, with special reference to the question whether Plants Assimilate Free or Uncombined Nitrogen (Philosophical Transactions, part 2, 1861) 1861
18. Report of Experiments made at Rodmersham, Kent, on the Growth of Wheat by different Descriptions of Manure for several years in succession on the same land (Jour. Roy. Ag. Soc. Eng., vol. xxiii., p. 31) .. 1862
19. The Effects of Different Manures on the Mixed Herbage of Grass Land (Jour. Roy. Ag. Soc. Eng., vol. xxiv., p. 131) 1863
20. On the Sources of the Nitrogen of Vegetation, with special reference to the question whether Plants assimilate Free or Uncombined Nitrogen (Jour. Chem. Soc., new series, vol. i.; entire series, vol. xvi.) 1863
21. Liebig and the "Mineral Theory" (note, extracted from a paper by Messrs. Lawes and Gilbert, Jour. Roy. Ag. Soc. Eng., vol. xxiv., part 2) 1863
22. Further Report of Experiments with Different Manures on Permanent Meadow Land (Jour. Roy. Ag. Soc. Eng., vol. xxiv., part 2) 1863
23. Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the same land (Jour. Roy. Ag. Soc. Eng., vol. xxv., parts 1 and 2) 1864
24. On the Selection of Artificial Manures for the Sugar-cane 1864
25. On the Accumulation of the Nitrogen of Manure in the Soil (Report of the British Association for the Advancement of Science for 1866) 1866
26. Preliminary Notice of Results on the Composition of Wheat grown for twenty years in succession on the same land (Report of the British Association for the Advancement of Science for 1867) 1867
27. On the Home Produce, Imports, and Consumption of Wheat (Jour. Roy. Ag. Soc. Eng., vol. vi., s.s., part 2) 1868
28. Exhaustion of the Soil in relation to Landlords' Covenants, and the Valuation of Unexhausted Improvements (read before the London Farmers' Club, April 4, 1870) 1870
29. Scientific Agriculture with a view to Profit (read before the Maidstone Farmers' Club, Dec. 15, 1870) 1870
30. Reports of Experiments on the Influence of various Manures on different Species of Plants (Proceedings of the Royal Horticultural Society) 1870
31. Effects of the Drought of 1870 on some of the Experimental Crops at Rothamsted (Jour. Roy. Ag. Soc. Eng., vol. vii., s.s., part 1) 1871
32. Notes on Clover Sickness (Jour. Roy. Hort. Soc., vol. iii.) 1871
33. Report of Experiments on the Growth of Barley for Twenty Years in Succession on the same land (Jour. Roy. Ag. Soc. Eng., vol. ix., s.s., parts 1 and 2) 1873
34. Unexhausted Tillages and Manures, with reference to the Landlord and Tenant (Ireland) Act, 1870 .. 1874
35. On the more frequent Growth of Barley on Heavy Land (read before the London Farmers' Club, Feb. 1, 1875) 1875
36. On the Valuation of Unexhausted Manures (Jour. Roy. Ag. Soc. Eng., vol. xi., s.s., part 1) 1875
37. Note on the Occurrence of "Fairy Rings" (Jour. Linn. Soc., Botany, vol. xv., p. 17) 1875
38. On some points in connection with Vegetation (Address delivered at South Kensington in the Chemical Section of the Science Conferences) 1876
39. On Rainfall, Evaporation, and Percolation (Proceedings of the Inst. of Civil Engineers, vol. xiv., part 3) 1876

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| <p>40. Freedom in the Growth and Sale of the Crops of the Farm, considered in relation to the interests of the Landowner and the Tenant Farmer (Jour. Soc. Arts, December 14, 1877) 1877</p> <p>41. On Nitrification; Part I, a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., January, 1878) 1878</p> <p>42. Composition of Potatos (Note—Jour. Roy. Hort. Soc., vol. v., part 5; Proceedings, p. xxxvii.) 1878</p> <p>43. Is Higher Farming a remedy for Lower Prices? (Lecture delivered before the East Berwickshire Agricultural Association, May 3, 1879. Published by G. Macaskie, 'Warder' Office, Berwick) .. 1879</p> <p>44. On Nitrification; Part II, a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., July, 1879) 1879</p> <p>45. On the Determination of Nitric Acid as Nitric Oxide, by means of its action on Mercury; a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., July, 1879) 1879</p> <p>46. On the Determination of Nitric Acid by means of Indigo, with special reference to Water Analysis;</p> | <p>a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., September, 1879) .. 1879</p> <p>47. Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Meadow, conducted for more than twenty years in succession on the same Land.—Abstract (Proceedings of the Royal Society, No. 197, 1879) 1879</p> <p>48. On some points in connection with Agricultural Chemistry.—Abstract (Report of the British Association for the Advancement of Science for 1879) .. 1879</p> <p>49. Our Climate and our Wheat-Crops (Jour. Roy. Ag. Soc. Eng., vol. xvi., s.s., part 1) 1880</p> <p>50. On the Home Produce, Imports, Consumption, and Price of Wheat, over twenty-eight (or twenty-seven) harvest-years, 1852-53 to 1879-80 inclusive (Jour. of the Statistical Society, June, 1880) 1880</p> <p>51. Agricultural, Botanical, and Chemical Results of Experiments on the Mixed Herbage of Permanent Meadow, conducted for more than twenty years in succession on the same Land.—Part I. The Agricultural Results (Philosophical Transactions, part 1, 1880) 1880</p> |
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SERIES II.—REPORTS OF EXPERIMENTS ON THE FEEDING OF ANIMALS, SEWAGE UTILISATION, &c.
PUBLISHED 1849—1877, INCLUSIVE.

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| <p>1. Agricultural Chemistry: Sheep Feeding and Manure, Part I. (With Tabular Appendix in 1856.) (Jour. Roy. Ag. Soc. Eng., vol. x., p. 276) 1849</p> <p>2. Report of Experiments on the Comparative Fattening Qualities of Different Breeds of Sheep; Hampshire and Sussex Downs (Jour. Roy. Ag. Soc. Eng., vol. xii., p. 414) 1851</p> <p>3. Report of Experiments on the Comparative Fattening Qualities of Different Breeds of Sheep—Cotswolds (Jour. Roy. Ag. Soc. Eng., vol. xiii., p. 179) .. 1852</p> <p>4. On the Composition of Foods in relation to Respiration and the Feeding of Animals (Report of the British Association for the Advancement of Science for 1852) 1852</p> <p>5. Agricultural Chemistry: Pig Feeding (Jour. Roy. Ag. Soc. Eng., vol. xiv., p. 459) 1853</p> <p>6. On the Equivalency of Starch and Sugar in Food (Report of the British Association for the Advancement of Science for 1854) 1854</p> <p>7. Experiments on the Comparative Fattening Qualities of Different Breeds of Sheep—Leicesters and Cross-breds (Jour. Roy. Ag. Soc. Eng., vol. xvi., p. 45) .. 1855</p> <p>8. On the Sewage of London (Journal of the Society of Arts, March 7, 1855) 1855</p> <p>9. Letter on the Utilisation of Town Sewage (from the Report ordered by the House of Commons to be printed, Aug. 3, 1857. Appendix xii., p. 477) .. 1857</p> <p>10. Experimental Inquiry into the Composition of some of the Animals Fed and Slaughtered as Human Food. Abstract (Proceedings of the Royal Society of London, vol. ix., p. 348) 1858</p> <p>11. Observations on the recently-introduced Manufactured Foods for Agricultural Stock (Jour. Roy. Ag. Soc. Eng., vol. xix., p. 199) 1858</p> <p>12. Experimental Inquiry into the Composition of some of the Animals Fed and Slaughtered as Human Food (Philosophical Transactions, Part 2, 1859) .. 1859</p> <p>13. On the Composition of Oxen, Sheep, and Pigs, and of their Increase while Fattening (Jour. Roy. Ag. Soc. Eng., vol. xxi., p. 433) 1860</p> <p>14. On the Composition of the Animal Portion of our</p> | <p>Food, and on its relations to Bread—Abstract (Jour. Chem. Soc., vol. xii., p. 54) 1860</p> <p>15. Fifth Report of Experiments on the Feeding of Sheep (Jour. Roy. Ag. Soc. Eng., vol. xxii., p. 189) .. 1861</p> <p>16. Report of Experiments on the Fattening of Oxen at Woburn Park Farm (Jour. Roy. Ag. Soc. Eng., vol. xxii., p. 200) 1861</p> <p>17. Experiments on the Question whether the Use of Condiments increases the Assimilation of Food by Fattening Animals, or adds to the Profits of the Feeder (Edinburgh Veterinary Review and Annals of Comparative Pathology, July, 1862) 1862</p> <p>18. Supplementary Report of Experiments on the Feeding of Sheep (Jour. Roy. Ag. Soc. Eng., vol. xxiii., p. 191) 1862</p> <p>19. The Utilisation of Town Sewage (Jour. Roy. Ag. Soc. Eng., vol. xxiv., p. 65) 1863</p> <p>20. On the Chemistry of the Feeding of Animals for the Production of Meat and Manure (read before the Royal Dublin Society, March 31, 1864) 1864</p> <p>21. On the Sewage of Towns (Third Report and Appendices 1, 2, and 3, of the Royal Commission. Presented to Parliament) 1865</p> <p>22. Report (presented to Parliament) of Experiments undertaken by Order of the Board of Trade to Determine the Relative Values of Unmalted and Malted Barley as Food for Stock 1866</p> <p>23. On the Composition, Value, and Utilisation of Town Sewage (Jour. Chem. Soc., New Series, vol. iv.; Entire Series, vol. xix.) 1866</p> <p>24. Food, in its Relations to the various Exigencies of the Animal Body (Phil. Mag., July, 1866) .. 1866</p> <p>25. On the Sources of the Fat of the Animal Body (Phil. Mag., December, 1866) 1866</p> <p>26. Note—On Sewage Utilisation (Proceedings of the Institution of Civil Engineers, vol. xiv., Part 3) .. 1876</p> <p>27. On some Points in connection with Animal Nutrition (Address delivered at South Kensington in the Biological Section of the Science Conferences) .. 1876</p> <p>28. On the Formation of Fat in the Animal Body (Journal of Anatomy and Physiology, vol. xi., Part 4) .. 1877</p> |
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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.

During the first 19 years of the experiments, 1856-1874, the first crop only, each year, was mown, made into hay, removed from the land, and weighed. As a rule, the second crop was fed-off by sheep having no other food, the object being not to disturb the condition of the manuring. Frequently, however, the animals suffered considerably; and in 1866, 1870, 1873, and 1874, the second crops (and third, if any) were cut, and spread on the respective Plots. In the twentieth season, 1875, the second crops being unusually heavy, and the weather favourable, they were, for the first time, cut, weighed as hay, and removed. In 1876 they were cut and spread on the Plots. In 1877 and 1878 the second crops were again made into hay, weighed, and removed; and it is intended, in future, to adopt this plan, whenever the weather will permit. In 1879 the second crops were cut, sampled, carted, and weighed, green; the dry matter in the weighed samples was determined, and the produce reckoned into hay by adding one-fourth to the calculated dry matter per acre.

(Area under experiment, about 7 acres.)

1 ton,	0.40 Hectare	.. .. .	or 1.59 Prussian Morgen.
1 lb. (round avo.)	0.45 Kilogramme	.. .. .	or 0.91 Zollverein Pfund.
1 cwt. (hundredweight)	51.0 Kilogrammes	.. .. .	or 1.02 Centner.
1 ton	1016.0 Kilogrammes	.. .. .	or 20.33 Centner.
1 lb. per acre	1.12 Kilogrammes per Hectare	or	0.57 Zoll. Pfd. per Pr. Morgen.
1 cwt. per acre	125.5 Kilogrammes per Hectare	or	0.64 Centner per Pr. Morgen.
1 ton per acre	2510.0 Kilogrammes per Hectare	or	12.82 Centner per Pr. Morgen.

Manures, per acre, per Annum.

PLOTS.	PRODUCE PER ACRE, WEIGHED AS HAY.												PLOTS.
	Average per Annum. (First Crops only.)						Twenty-third Season, 1878.			Twenty-fourth Season, 1879.			
	10 Years, 1866-67, 1866-75.	10 Years, 1866-75.	20 Years, 1866-75.	First Crop.	Second Crop.	Total.	First Crop.	Second Crop.	Total.	First Crop.	Second Crop.	Total.	
1	48½	37½	43	39½	17½	48½	43½	15	43½	43½	15	56½	1
2	41½	32	36½	21	15½	36½	33½	12½	33½	12½	46	2	
3	22½	20	21½	16½	13½	29½	27	11½	27	11½	38½	3	
4	23½	21½	22½	19½	15½	34½	29½	11½	41	11½	56½	4	
5	33½	30½	32½	21½	18½	54	45½	11	56½	11	66½	5	
6	30½	22	26½	17½	13½	36	28	8	36	8	44	6	
7	31½	30½	30½	37	18½	55½	43	11½	55½	11½	67½	7	
8	33½	36½	35½	35	22½	57½	40½	14	54½	14	68½	8	
9	33½	26½	30½	22½	17½	40	30½	9½	40½	9½	50½	9	
10	53½	48½	51	56	24½	80½	68½	14½	83	14½	97½	10	
11	52½	39½	46½	41	22	63	51	14½	65½	14½	80½	11	
12	61½	53½	57½	51½	41½	93	64½	21½	86	21½	107½	12	
13	63½	61½	62½	60	38	98	67	21½	88½	21½	110½	13	
14	25	22½	24	16½	16	32½	28½	9½	37½	9½	47	14	
15	55½	59½	57½	55	29½	84½	66½	16½	83	16½	99½	15	
16	53½	60½	57	48	15½	63½	53½	15½	68½	15½	84	16	
17	36½	35	35½	25½	21½	46½	34½	11	45½	11	56½	17	
18	45½	47½	46½	42½	20½	63½	48	11½	59½	11½	71	18	
19	34½	33½	33½	27½	14½	41½	37½	9½	47	9½	56½	19	
20	81	83½	82½	34½	17½	51½	47	11	58	11	69	20	

(7) The application of Silicates did not commence until 1862; 9 years (1862-1870), 200 lbs. Silicate Lime, and 200 lbs. Silicate Soda; 1871, and 11 years, 400 lbs. Silicate Soda.
 (8) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. of "Ammonia-salts."
 (9) The manures specified were first applied in 1859 (previously, 1856-7 and 8, Sawdust only).
 (10) Averages of 8 years, 10 years, and 18 years, as these experiments did not commence until 1858.
 (11) Averages of (1 year), 10 years, and 11 years, as the experiment only commenced in 1865.
 (12) Averages of 4 years only, 1872-75.

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 4 1/2 acres.)

Plots.	PRODUCES PER ACRE.											Plots.		
	Average per Annum.													
	Dressed Corn.				Total Straw.				Twenty-eighth Season, 1879.					
	Quantity.		Weight per Bushel.		Quantity.		Weight per Bushel.		Quantity.	Weight per Bushel.	Total Straw.			
1 O. 2 O. 3 O. 4 O.	Manures, per acre, per annum.											1 O. 2 O. 3 O. 4 O.		
	Unmanured continuously												1 A. 2 A. 3 A. 4 A.	
	34 cwt. Superphosphate of Lime (1)													1 A.A. 2 A.A. 3 A.A. 4 A.A.
	200 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia													
200 lbs. Sulphate of Potash, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 3 1/2 cwt. Superphosphate														
200 lbs. Ammonia-salts (2)											1 A.A.S. 2 A.A.S. 3 A.A.S. 4 A.A.S.			
200 lbs. Ammonia-salts, and 3 1/2 cwt. Superphosphate														
200 lbs. Ammonia-salts, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
200 lbs. Ammonia-salts, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
275 lbs. Nitrate Soda											1 C. 2 C. 3 C. 4 C.			
275 lbs. Nitrate Soda, and 3 1/2 cwt. Superphosphate														
275 lbs. Nitrate Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
275 lbs. Nitrate Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (3)											1 N. 2 N.			
275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, and 3 1/2 cwt. Superphosphate (3)														
275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.														
275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., and 3 1/2 cwt. Superphosphate														
1000 lbs. Rape-cake											5 O. 5 A. M.			
1000 lbs. Rape-cake, and 3 1/2 cwt. Superphosphate														
1000 lbs. Rape-cake, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
1000 lbs. Rape-cake, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
275 lbs. Nitrate of Soda											6 (1) 7 (1)			
275 lbs. Nitrate of Soda, and 3 1/2 cwt. Superphosphate (4)														
275 lbs. Nitrate of Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
275 lbs. Nitrate of Soda, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3 1/2 cwt. Superphos.														
Unmanured continuously											1 C. 2 C. 3 C. 4 C.			
Ashes (burnt soil and turf)														
Farnyard Manure 14 tons, 20 yrs., 1852-71, av. prod. 48 1/2 bush.; unmanured since, av. prod., 7 yrs., 1872-8, 36 1/2 bush.														
Farnyard Manure 14 tons, every year; av. prod., 20 years, 1852-71, 48 1/2 bush.; 7 years, 1872-8, 49 1/2 bush.														

(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 parts Sulphate and Nitrate of Ammonia of Commerce.
 (5) First 6 years, 1852-7, instead of Nitrate of Soda, 450 lbs. Ammonia-salts per annum; next 10 years, 1858-67, 200 lbs. Ammonia-salts 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."
 (6) The application of Sulphates did not commence until 1864; in 1864-5-6 and 7, 200 lbs. Silicate of Soda and 200 lbs. Sulphate of Soda were applied per acre, but in 1868, and since, 400 lbs. Silicate of Soda, and no Silicate of Lime. These plots ("AAS") comprise, respectively, one half of the original "AA" plots, and, excepting the addition of the Silicates, have been, and are, in other respects, manured in the same way as the "AA" plots.
 (7) 300 lbs. Rape-cake per annum for the first six years, and 1000 lbs. only, each year since.
 (8) 200 lbs. Sulphate of Potash, and 3 1/2 cwt. Superphosphate of Lime, without Nitrate of Soda, the first year (1852); Nitrate alone each year since.
 (9) 550 lbs. Nitrate of Soda for 1853-4-5-6, and 7; and 275 lbs. only, each year since.
 (10) Ammonia-salts also the first year, but not since.
 (11) Averages of 12 years, 13 years, and 25 years.
 (12) Averages of 7 years, 13 years, and 20 years.
 (13) Averages of 20 years (with dung), 6 years (unmanured), and 26 years.
 (14) Produce not weighed, owing to the foulness from the wet season.
 (15) By mistake 400 lbs. in 1880.

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 29 years (1852 and since). From the commencement of the experiments in 1843-4 up to 1876-7 inclusive, the mineral manures, the ammonia-salts, and rape-cake, &c., if any, were sown in the autumn, before the seed; excepting in 1845, when, owing to the wet autumn and winter, all the manures were spring-sown; and for the crops of 1873, 4, 5, 6, and 7, the ammonia-salts applied to Plot 15 were top-dressed in the spring. Nitrate of soda has, however, always been sown in the spring. But, in consequence of the ascertained great loss of the nitrogen of the manures by drainage, especially in wet winters, it has been decided to apply only the mineral manures (and Farmyard-manure) in the autumn, and the ammonia-salts, as well as the nitrate, in the spring; excepting on Plot 15, where, for comparison, the ammonia-salts are sown in the autumn. This plan was adopted for the first time for the crop of 1875.

(Area under experiment, about 13 acres.)

PLOTS.	Manures, per acre, per annum.	PRODUCE PER ACRE.												PLOTS.				
		Average per Annum.						Thirty-Sixth Season, 1878.										
		Dressed Corn.			Total Straw.			Dressed Corn.			Total Straw.							
		Quantity.	Weight per Bushel.	Quantity.	Weight per Bushel.	Quantity.	Weight per Bushel.	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)	18½	16½	15½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	1½	0
1	Sulphates of Potash, Soda, and Magnesia (twice as much as on No. 5 and succeeding Plots)	16½	14½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	1½	0	1
2	Farmyard Manure (14 tons every year)	15½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	1½	0	2	
3	Unmanured continuously	17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	3
4	Unmanured for Crop of 1852, and since; previously Superphosphate (made with Muriatic Acid), and Sulphate Ammonia	18½	16½	15½	14½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	4
5 (a and b)	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphosphate of Lime (a)	28½	26½	25½	24½	23½	22½	21½	20½	19½	18½	17½	16½	15½	14½	13½	12½	5 (a and b)
6 (a and b)	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphos., 200 lbs. Ammonia-salts (a)	37½	35½	34½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	6 (a and b)
7 (a and b)	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphos., 400 lbs. Ammonia-salts	38½	36½	35½	34½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	7 (a and b)
8 (a and b)	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphos., 600 lbs. Ammonia-salts	35½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	8 (a and b)
9 (a and b)	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwt. Superphos., 550 lbs. Nitrate Soda (a)	26½	24½	23½	22½	21½	20½	19½	18½	17½	16½	15½	14½	13½	12½	11½	10½	9 (a and b)
10 (a and b)	400 lbs. Ammonia-salts alone, for 1843, and each year since; Mineral Manure in 1844	27½	25½	24½	23½	22½	21½	20½	19½	18½	17½	16½	15½	14½	13½	12½	11½	10 (a and b)
11 (a and b)	400 lbs. Ammonia-salts alone, for 1845, and each year since (except 1846 and 1850); Mineral Manure 1844, 48, 50	30½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	18½	17½	16½	15½	14½	11 (a and b)
12 (a and b)	400 lbs. Ammonia-salts, 3½ cwt. Superphosphate	35½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	12 (a and b)
13 (a and b)	400 lbs. Ammonia-salts, 3½ cwt. Superphosphate, and 200 lbs. of Sulphate of Soda	35½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	13 (a and b)
14 (a and b)	400 lbs. Ammonia-salts, 3½ cwt. Superphosphate, and 280 lbs. of Sulphate of Magnesia	35½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	14 (a and b)
15 (a and b)	200 lbs. of Sulph. Pot., 100 lbs. of Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwt. Superphos. (a); 400 lbs. Amm.-salts, in Autumn. (a)	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	15 (a and b)
16 (a and b)	200 lbs. of Sulph. Pot., 100 lbs. of Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwt. Superphos. (a); 400 lbs. Amm.-salts, in Autumn. (a)	35	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	15 (a and b)
17 (a and b)	1852-64, 13 years, 200 lbs. Sulph. Potash, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwt. Superphos., and 800 lbs. Ammonia-salts; average produce 39½ bush. Corn, 46½ cwt. Straw	39½	37½	36½	35½	34½	33½	32½	31½	30½	29½	28½	27½	26½	25½	24½	23½	16 (a and b)
18 (a and b)	1855 and since, unmanured; average produce (14 years, 1865-77) 15½ bushels Corn, 19½ cwt. Straw	32½	30½	29½	28½	27½	26½	25½	24½	23½	22½	21½	20½	19½	18½	17½	16½	17 (a and b)
19	200 lbs. of Sulphate Potash, 100 lbs. of Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate	18½	16½	15½	14½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	18 (a and b)
20	1878-9, and since, 1700 lbs. Rape-cake; 1852-78, 3½ cwt. Superph. Lime (a), 300 lbs. Sulph. Am., and 500 lbs. Rape-cake, in Autumn.	32	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	19
21	Unmanured continuously	15½	13½	12½	11½	10½	9½	8½	7½	6½	5½	4½	3½	2½	1½	0	20	
22	200 lbs. of Sulph. Potash, 100 lbs. of Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwt. Superphos., 100 lbs. Muriate Ammonia	22½	20½	19½	18½	17½	16½	15½	14½	13½	12½	11½	10½	9½	8½	7½	6½	21
22	200 lbs. of Sulph. Potash, 100 lbs. of Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwt. Superphos., 100 lbs. Sulphate Ammonia	22	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	22

(a) 300 lbs. per annum for Crop of 1858, and previously.
 (b) 200 lbs. per annum for Crop of 1853, and previously.
 (c) 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).
 (d) The "Ammonia-salts," in all cases, equal parts Sulphate and Muriate of Ammonia of Commerce.
 (e) 96, 475 lbs. Nitrate Soda in 1852, 275 lbs. in 1853 and 1854, 550 lbs. each year since. No Sulphate of Potash, Soda, or Magnesia, or Superphosphate, in 1852, 1853, or 1854. 96, 475 lbs. Nitrate in 1852, 550 lbs. each year since. 550 lbs. Nitrate is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."
 (f) For 1858, and previously—1½ time as much.
 (g) For 1872 and previously, made with Muriatic instead of Sulphuric Acid.
 (h) For 1872 and previously, 400 lbs. Sulphate Ammonia, sown in the Autumn; for 1873, 4, 5, 6, and 7, 400 lbs. Ammonia-salts, sown in the Spring; for 1878 and since, 400 lbs. Ammonia-salts, sown in the Autumn.
 (i) For 1872 and previously, 300 lbs. Sulphate Ammonia and 500 lbs. Rape-cake, sown in the Autumn; for 1873, 4, 5, 6, and 7, 400 lbs. Ammonia-salts, sown in the Spring; for 1878 and since, 400 lbs. Ammonia-salts, sown in the Autumn.
 (j) For 1872 and previously, 300 lbs. Sulphate Ammonia and 500 lbs. Rape-cake, sown in the Autumn; for 1873, 4, 5, 6, and 7, 400 lbs. Ammonia-salts, sown in the Spring; for 1878 and since, 400 lbs. Ammonia-salts, sown in the Autumn.

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.

The first Experimental Oat Crop was in 1869; the last in 1878, since which time, owing to the wetness and the foulness of the land, it has been left fallow.

(Area under Experiment, $\frac{2}{3}$ 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.		Dressed Corn.		Dressed Corn.		Dressed Corn.		Dressed Corn.		Dressed Corn.	
		Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.
		Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.
1	Unmanured	36½	36½	16½	35	20½	33½	15	36½	10½	27½	18½	38½
2	{ 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate of Lime (1) }	45	38½	19½	35½	22	35½	19½	37½	10½	28½	24½	35
3	{ 400 lbs. Ammonia-salts (2) }	56½	37½	30	34½	57½	36½	55½	37½	30½	32½	47	35½
4	{ 400 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate }	75½	39½	50½	36	58½	35½	62½	39½	45½	34½	59	37
5	{ 550 lbs. Nitrate of Soda (3) }	62½	38½	36½	35½	55	36½	42½	36½	20½	30½	47½	35½
6	{ 550 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate }	69½	38½	50	35½	60½	33½	44½	37½	24	33½	57½	35½
SECOND 5 YEARS; MINERAL MANURES AS BEFORE, AMMONIA-SALTS AND NITRATE OF SODA ONLY HALF AS MUCH AS PREVIOUSLY.													
		6TH SEASON, 1874.		7TH SEASON, 1875.		8TH SEASON, 1876 (4).		9TH SEASON, 1877 (5).		10TH SEASON, 1878.		AVERAGE PER ANNUM 4 YEARS, 1874, 5, 6, and 8.	
		Dressed Corn.		Dressed Corn.		Dressed Corn.		Dressed Corn.		Dressed Corn.		Dressed Corn.	
		Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.	Quantity, Bushels.	Weight per Bushel, lbs.
		Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.	Total Straw, cwt.
1	Unmanured	12	31½	12½	29½	8½	32	..	..	22½	32	13½	31½
2	{ 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate of Lime (1) }	13½	31½	13½	29½	7½	30	..	..	17½	32½	13½	31½
3	{ 200 lbs. Ammonia-salts (2) }	37½	33½	30½	32½	17½	34½	..	..	30	32½	28½	33½
4	{ 200 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate }	46½	34½	30½	34½	26½	35½	..	..	45½	37	38	35½
5	{ 275 lbs. Nitrate of Soda (3) }	35½ (4)	30 (4)	23½ (4)	31½ (4)	12½	30½	..	..	34½	34½	26½	31½
6	{ 275 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwt. Superphosphate }	28½ (4)	33½ (4)	28½ (4)	33½ (4)	19½	33½	..	..	37	36½	28½	34½

(1) "Superphosphate of Lime"—in all cases, made from 200 lbs. Bonesash, 150 lbs. Sulphuric Acid sp. gr. 1.7 (and water).
 (2) "Ammonia-salts"—in each case, equal parts Sulphate and Muriate of Ammonia of Commerce.
 (3) 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. "Ammonia-salts."
 (4) On these plots, where large quantities of Nitrate of Soda had been applied year after year, the land, though more worked, was so wet that it could not be got into favourable condition for sowing, and the plant was very irregular.
 (5) Owing to the extremely wet condition of the land, especially on the Nitrate plots, it was not sown until April 6, and then with a very unfavourable seed bed; and there being a heavy fall of snow a week later, the plant came up very irregularly, and much of it perished from standing surface-water.
 (6) Owing to the very wet winter, 1876-7, the land could not be worked in time for sowing, and was therefore left fallow in 1877; no manures being applied.

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. In 1875 Beans were re-sown, with the same manures on the respective plots as in 1864-1870; but owing to the wetness of the land in the first instance, and the subsequent hindrance by other spring sowing, they were not put in until April 1 and 2. The wetness of the winter 1875-6, again prevented the preparation of the land in due time; and, though the manures were sown, and the land ploughed, it was left fallow during the summer of 1876. Winter Beans were put in (drilled), without further manuring, early in October, 1876. In 1878 the usual manures were sown, and beans were drilled on February 26. Owing to the wetness of the winter, and the condition of the land, it was left fallow in 1879; and owing to its continued wetness and foulness, it still remains fallow (May 1880.)

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 Gramineaceous 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 cwts. 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. On October 23, 1874, wheat was sown without manure. Beans should have been sown in 1876; indeed, the manures were sown, but, for the reason stated above, the land was left fallow; and wheat was put in October 24 (1876). In 1878 Beans were drilled, on February 26, with the usual manures. Owing to the wetness of the winter, and the condition of the land, it was left fallow in 1879; and it continues so up to the present time (May 1880).

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.

EXPERIMENTS ON THE GROWTH OF LEGUMINOUS CROPS—*continued*.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, the beneficial effects of long previous applications of potass are apparent when 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 was sown 10 times during the 23 years, 1848–1870, 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 shown very luxuriant growth almost every year since. Seed was re-sown 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 was sown between the rows on May 4, and this failing, again on July 7, 1874. Small cuttings were taken June 11, July 22, and September 30, 1874. A small cutting was again taken on June 22, 1875. On July 13 the old plants were dug in, and seed again sown, and this failing, seed was re-sown September 22. In spring 1876 there was luxuriant growth, but deficient plant; from which two small cuttings were taken, on June 26, and August 7. On September 1 (1876), the beds were dug up, and resown with seed, which came up fairly, but the plant suffered during the winter, and in May 1877 it was dug up and resown. From this sowing a cutting was taken on September 5, 1877; and three cuttings in 1878, on June 10, July 26, and November 1. In May, 1879, there remained some fairly vigorous plants, but not nearly enough for a crop, so the ground was dug up (the soil sampled), the plants then dug in, and fresh seed was sown, on May 21. From this sowing a cutting was taken on Sep-

tember 13. Owing to injury from Dodder in the autumn, and the subsequent severity of the winter, the plant again died off, and seed was sown afresh on April 17, 1880. This (1880) is the 27th 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 quantities 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, and sown with Red Clover seed, May 5, without manure. The plant came up well, and was very forward in September, when the flowering stems were cut down, but left on the land. During the winter and early spring the plant on those portions from which cuttings had been taken in 1871 almost entirely failed, and the land was ploughed up in May, and again in August (1873); whilst on those from which none had been taken since 1869 a fair plant remained, and two small cuttings were obtained, namely on June 23, and on August 9 and 12 (1875). On September 22, this portion of the land was ploughed up. In May (1876) the whole was re-ploughed, again in July and September, and left fallow. In May 1877, Barley and Clover were sown over the whole of the experimental Land, without further manuring, but the clover plant completely died off during the winter. At the present

EXPERIMENTS ON THE GROWTH OF LEGUMINOUS CROPS—*continued*.

time (1880) the land is devoted to experiments with various Leguminous plants, which were commenced in 1878.

In the spring of 1871 the *small* plots in the field were again re-sown, and those of them with 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 was, therefore, dug in. The artificially-manured plots were re-manured as before, but only to the depth of 9 inches, and seed was sown on May 4th, July 6th, and October 22nd; each time the plant coming up well, but subsequently dying off. On the Garden soil plots, the plant from the first sowing (May 4), for the most part stood; requiring only to be made good here and there on July 6; and in September small cuttings were taken. In May, 1875, the plant was entirely gone on the artificially-manured plots, which were then dug up, and prepared for resowing. On the garden soil plots, though the rows were imperfect, some healthy plants still remained, and gave a small cutting on June 22. On July 24 these plots were dug up; and they, as well as the artificially manured ones just referred to, were re-sown with seed. All came up well, but in May (1876), the plants on the garden soil plots were entirely gone, and those on the artificially manured ones nearly so, but they yielded small cuttings on July 17. More small plots were arranged in the spring of 1874; on which the manures were dug in, at the various depths, on May 11th to 14th, and the seed sown on May 16th. One series received sulphate of potass only, another nitrate of soda only, and a third the two together. The plants came up fairly well, but there were some blanks in the rows, which were re-sown on October 22 (1874). A cutting was taken on June 22 and 23 (1875); the blanks in the rows were re-sown on July 24; a second cutting taken on August 17; and the blanks again re-sown on September 22 (1875). The plant was the most even on the plots with sulphate of potass, less so on those with nitrate of soda, and less still on those with both together. The amount of produce was also greater with each of the manures used separately, than with the mixture of the two. The plants on these new artificially manured plots, like those on the older ones, showed failure in the spring of 1876; but also, like them, gave small cuttings in July. All the small beds were dug up in August; the artificially manured ones re-manured as in 1874, the manures dug in to a depth of 9 inches, and seed was sown on September 1, which came up, but the plants died off on all the plots in the winter of 1876-7. In May 1877, all the small beds were dug up, and sown with Barley and Clover. To try the effects of shelter, the Barley stubble was left unusually high, but the young clover plants completely died off during the winter (1877-8). In the spring of 1878 the beds were dug up, and cleaned; and they were re-sown with Clover, without further manuring, on June 12 and 13. All came up well, but the plant was almost entirely destroyed by "Fly." In May 1879, there remained about a quarter of a plant on the plot with the largest amount of mineral manure,

including potass, and sown to the greatest depth, and perhaps a third of a plant where the same mineral manures, with nitrate of soda in addition, had been applied; but there was scarcely a single plant on any of the other plots. On June 9 and 10, 1879, all the beds were cleaned, and re-sown with seed, which came up well; but a very wet and cold season following, most of the plants died off during the summer and autumn. Early in June 1880, all the small beds were cleaned, and forked up; and on June 10, they were re-sown with seed without further manure.

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 supplied 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 coincidentally 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 of the Royal Agricultural Society of England,' vol. xxi. Part I. p. 178; and 'Journal of the 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."

EXPERIMENTS ON ROOT-CROPS.—BARN FIELD.

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 equalise 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 arranged in 1856, having regard to the character of the manures previously applied on the different Plots, and to the results previously obtained. This second series was continued for fifteen years, namely, from 1856 to 1870 inclusive. The results obtained with Norfolk Whites in the first three years, 1843, 1844, and 1845, were published in the 'Journal of the Royal Agricultural Society of England,' vol. viii. Part II., 1847; and an abstract of the results obtained from 1845 to 1870 inclusive, is given in the Table below. During the five years, 1871-1875, the land was devoted to experiments with Sugar-Beet, for particulars of which see pp. 16 and 17. In 1876 experiments with Mangold-wurzel were substituted, and are still in progress (see pages 18 and 19).

(Area under experiment, about 8 acres; quantities, average, per acre, per annum.)

NORFOLK WHITE TURNIPS; FOUR SEASONS, 1845-1848; Roots and Leaves carted off the Land.

SERIES 1. Manures as under; no Cross-dressing.		Each Plot as Series 1, and Cross-dressed as under—											
		SERIES 2. No Cross-dressing.		SERIES 3. 160 lbs. Sulphate Ammonia. 75 lbs. Muriate Ammonia.		SERIES 4. 160 lbs. Sulphate Ammonia. 75 lbs. Muriate Ammonia. 1840 lbs. Rape-cake.		SERIES 5. 1540 lbs. Rape-cake.					
		Average Produce, per Acre, per Annum.											
Plots.		Roots.		Leaves.		Roots.		Leaves.		Roots.		Leaves.	
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.		
3	Gypsum 1845; without Manure 1846 and since (average 1846, 7, 8)	1	4	0	17	1	7	1	0	5	10	3	19
4	Superphosphate, each year; Potass, Soda, and Magnesia, 1847-8 ..	8	1	2	15	9	15	4	3	10	5	6	1
5	Superphosphate, each year;	8	16	2	19	9	18	4	8	10	1	6	3
6	Superphosphate, each year; and Potass 1847-8	8	0	2	19	9	16	5	4	10	7	6	17
7														10	17	5	7

SWEDISH TURNIPS; FOUR SEASONS, 1849-1852; Roots and Leaves carted off the Land (excepting 1849, when the Leaves were too small to weigh or remove).

SERIES 1. Manures as under; no Cross-dressing.		Each Plot as Series 1, and Cross-dressed, as under, in 1849 and 1850. No Cross-dressing in 1851 and 1852.												
		SERIES 2. No Cross-dressing.		SERIES 3. 200 lbs. Ammonia-salts.		SERIES 4. 200 lbs. Ammonia-salts. 2000 lbs. Rape-cake.		SERIES 5. 2000 lbs. Rape-cake.						
		Average Produce, per Acre, per Annum.												
Plots.		Roots.		Leaves.		Roots.		Leaves.		Roots.		Leaves.		
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.			
3	Without Manure, 1846 and since	2	6	0	6	3	17	0	6	7	0	17	7	14
4	Superphosphate, Sulphates Potass and Magnesia, and Soda-ash ..	7	17	0	10	9	9	0	11	13	1	0	18	12
5	Superphosphate	7	9	0	11	8	14	0	13	11	4	1	1	10
6	Superphosphate, and Sulphate Potass	6	16	0	9	8	14	0	10	12	8	0	17	11
7														

BARLEY, without Manure (after Roots manured as above); THREE SEASONS, 1853-1855.

SERIES 1.		SERIES 2.										SERIES 3.		SERIES 4.		SERIES 5.	
		Dressed Corn.		Straw.		Dressed Corn.		Straw.		Dressed Corn.		Straw.		Dressed Corn.		Straw.	
		Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.		
3	.. .. .	18 $\frac{3}{4}$	12 $\frac{1}{2}$	20 $\frac{3}{4}$	12 $\frac{1}{2}$	20 $\frac{3}{4}$	12 $\frac{1}{2}$	20 $\frac{3}{4}$	12 $\frac{1}{2}$	20 $\frac{3}{4}$	12 $\frac{1}{2}$	25 $\frac{1}{2}$	16			
4	.. .. .	20 $\frac{3}{4}$	12 $\frac{1}{2}$	22 $\frac{3}{4}$	13	25	14 $\frac{1}{2}$	25 $\frac{1}{2}$	14 $\frac{1}{2}$	27	15 $\frac{1}{2}$	14 $\frac{1}{2}$	14 $\frac{1}{2}$			
5	.. .. .	21	11 $\frac{1}{2}$	23	12 $\frac{1}{2}$	26 $\frac{3}{4}$	15	27	15 $\frac{1}{2}$	27	15 $\frac{1}{2}$	15 $\frac{1}{2}$	15 $\frac{1}{2}$			
6	.. .. .	18 $\frac{3}{4}$	10 $\frac{1}{2}$	20 $\frac{3}{4}$	11 $\frac{1}{2}$	25	14 $\frac{1}{2}$	25	14 $\frac{1}{2}$	25	14 $\frac{1}{2}$	25	14 $\frac{1}{2}$			

SWEDISH TURNIPS; FIFTEEN SEASONS, 1856-1870. (?) Roots and Leaves carted off the Land.

SERIES 1. Manures as under; no Cross-dressing.		Each Plot as Series 1, and Cross-dressed as under—											
		SERIES 2. 5 years, 1856-1860. 3000 lbs. Saw-dust. 328 lbs. Nitric Acid.		SERIES 3. 5 years, 1856-1860. 200 lbs. Ammonia-salts.		SERIES 4. 5 years, 1856-1860. 200 lbs. Ammonia-salts. 3000 lbs. Sawdust.		SERIES 5. 5 years, 1856-1860. 3000 lbs. Sawdust.					
		Average Produce, per Acre, per Annum.											
Plots.		Roots.		Leaves.		Roots.		Leaves.		Roots.		Leaves.	
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	
1	Farmyard Manure, 14 tons	6	4	0	17	7	9	1	2	8	8	1	4
2	Farmyard Manure, 14 tons, and Superphosphate	6	7	0	16	7	13	1	3	8	5	1	5
3	Without Manure, 1846, and since	0	11	0	3	0	19	0	4	0	13	0	3
4	Superphosph., each year; Sulph. Potass, Soda, and Magnesia, 1856-60	2	16	0	8	5	2	0	16	4	12	0	14
5	Superphosphate, each year	2	12	0	9	4	13	0	18	3	16	0	15
6	Superphosphate, each year; Sulphate Potass, 1856-1860	2	7	0	7	4	11	0	14	4	5	0	13
7	Superphosph., each year; Sulph. Potass, and 36 $\frac{1}{2}$ Amm.-salts, 1856-60	2	12	0	7	4	13	0	14	4	12	0	14
8	Unman. 1853, and since; previously part Unman.; part Superphosph.	1	3	0	4	1	13	0	5	1	2	0	5

NOTE.—"Sulphate of Ammonia" is estimated to contain 23 per cent. Ammonia, and "Muriate of Ammonia" 27 per cent. "Ammonia-salts" in each case, equal parts Sulphate and Muriate of Ammonia of commerce; and the mixture is estimated to contain 25 per cent. Ammonia. The 328 lbs. Nitric Acid (Sp. gr. 1.35), mixed with sawdust, and used as a cross-dressing on the Plots of Series 2, from 1856-1860, were estimated to contain Nitrogen = 30 lbs. Ammonia.
(1) The crops of 1859 and 1860 failed, and were ploughed in; but, as the manures were applied, and there would be accumulation within the soil for the succeeding crops, the average produce is calculated as for 15 years, that is the produce of the 15 years is, in each case, divided by 15.

EXPERIMENTS ON SUGAR BEET—BARN FIELD—*continued*.

SUMMARY OF THE COMPOSITION OF THE SUGAR-BEET ROOTS.

As it will be some time before we shall be able to report fully the results obtained illustrating the influence of different manures, and different seasons, on the composition of Sugar-beet, an abstract of the analytical results obtained is given below. In interpreting the figures it must be borne in mind that with forty different experiments each year, and in each year 4 or 5 or more times as much produce on some plots as on others, it would be impossible to sample each at its best, and all in the same condition of ripeness. Each year the seed was sown on all the Plots at the same time; and the samples (each consisting of the vertical fourths of 10 or 15 roots) were taken from all within a period of about a week, beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones. The dry matter, ash, and nitrogen, as given in the table, are determined in the roots themselves; but they have generally been determined in the expressed juice also. The sugar is determined in the juice; and calculated into its percentage in the roots, on the assumption that they contain uniformly 95 per cent. of juice. But, with roots varying so much in character of growth, size, and ripeness, this will not be the case. Nevertheless, the results so calculated, approximately, and usefully, represent both the actual and relative amounts of sugar in the various roots. It need only further be observed that although, in comparable cases, the larger crops generally give a juice containing a lower percentage of sugar and higher percentages of mineral matter and of nitrogen, yet the larger crops yielded very much more sugar over a given area of land.

For Manures and Produce, see facing page.	CROSS-DRESSED MANURES, PER ACRE, PER ANNUM.																			
	SERIES 1. No Cross-dressing.				SERIES 2. As Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.				SERIES 3. As Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."				SERIES 4. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."				SERIES 5. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			

FIRST SEASON, 1871. (Results in all cases the means of determinations made on two samples, collected at the end of October, and the end of November, respectively).

PLOTS.	Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
	SERIES 1.				SERIES 2.				SERIES 3.				SERIES 4.				SERIES 5.			
	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
1	17.04	11.77	0.821	0.142	14.83	9.76	0.945	0.184	16.07	11.05	0.934	0.246	14.73	9.36	1.021	0.244	15.44	10.25	0.892	0.192
2	17.24	11.91	0.826	0.146	15.03	9.80	0.970	0.200	15.12	9.95	0.977	0.213	14.80	9.23	0.988	0.249	16.11	10.80	0.909	
3	17.47	12.31	0.711		15.36	10.37	0.861		17.75	10.98	0.901		16.71	9.66	0.915		16.95	11.72	0.758	
4	18.07	12.99	0.738		15.72	10.81	0.828		18.68	11.87	0.907		16.87	9.90	1.002		16.61	11.69	0.767	
5	17.89	13.23	0.746		15.93	11.07	0.787		16.36	11.44	0.754		14.63	9.28	0.843		16.84	11.85	0.722	
6	18.09	13.00	0.778		15.29	10.47	0.856		16.33	11.51	0.843		15.28	9.71	0.956		17.05	12.08	0.812	
7	17.97	13.17	0.762		15.86	10.49	0.901		16.71	11.50	0.826		15.99	10.23	0.904		17.57	12.30	0.782	
8	18.32	13.02	0.791		15.98	11.07	0.856		16.08	10.88	0.764		14.90	9.33	0.806		16.73	11.93	0.747	

SECOND SEASON, 1872. (Samples collected early in November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	18.23	12.97	0.874		17.07	12.04	0.973		17.07	11.95	0.962		17.17	12.07	0.930		17.75	12.35	0.925	
2	18.07	13.04	0.822		15.97	11.12	1.000		16.04	10.43	0.982		17.07	11.81	0.965		17.95	12.82	0.875	
3	19.22	13.99	0.767		17.83	12.78	0.823		19.62	14.38	0.691		17.87	12.60	0.720		19.12	13.95	0.683	
4	19.08	14.16	0.778	0.110	16.97	12.19	0.860	0.148	18.55	13.32	0.800	0.128	18.49	12.66	0.965	0.184	18.67	13.58	0.795	0.139
5	18.67	13.92	0.712	0.101	16.37	11.16	0.866	0.167	18.40	13.02	0.734	0.167	15.82	10.40	0.918	0.250	18.07	13.22	0.705	0.159
6	18.83	13.81	0.772	0.098	17.08	11.88	0.891	0.167	18.70	13.46	0.837	0.166	17.38	12.15	0.879	0.173	18.41	13.17	0.780	0.162
7	19.03	13.94	0.742		16.66	11.22	0.937		18.71	13.35	0.787		17.98	12.83	0.797		19.01	14.06	0.809	
8	18.69	..	0.701		16.84	..	0.911		..	..	0.790		18.00	..	0.738		18.95	..	0.685	

THIRD SEASON, 1873. (Samples collected from November 10 to November 14.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	17.62	12.73	0.924		16.64	11.20	0.947		16.76	11.33	0.965		18.80	10.21	1.267		16.88	11.64	0.887	
2	18.49	13.02	0.847		16.35	10.75	0.973		16.54	11.59	0.951		13.39	10.29	0.905		16.33	11.52	0.960	
3	18.96	13.84	0.710		16.97	11.89	0.843		18.76	13.07	0.762		16.00	11.24	0.755		17.94	14.20	0.735	
4	18.80	13.81	0.796	0.132	17.97	12.06	0.934	0.181	18.31	13.11	0.877	0.161	16.67	11.21	0.974	0.187	18.30	13.18	0.861	0.149
5	19.25	14.27	0.679	0.121	16.89	11.50	0.847	0.184	18.24	13.17	0.604	0.186	16.66	11.65	0.734	0.227	18.93	13.48	0.664	0.160
6	19.64	14.35	0.757	0.119	17.94	12.49	0.810	0.169	18.42	13.21	0.894	0.140	17.56	11.89	0.906	0.212	18.22	12.97	0.845	0.148
7	19.63	14.43	0.747		17.42	11.71	0.907		18.81	13.72	0.858		17.68	12.11	0.870		19.00	13.09	0.852	
8	20.22	14.66	0.742		16.50	10.90	0.917		18.47	13.20	0.756		16.54	10.83	0.782		18.06	13.07	0.695	

FOURTH SEASON, 1874 (1). Mineral Manures as in 1872 and 1873; but no Farnyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	14.66	11.15	1.100		14.27	10.16	1.089		14.35	9.79	1.112		13.53	10.24	1.029		14.39	10.85	0.972	
2	15.00	12.75	1.022		13.84	9.93	1.082		14.24	10.11	1.081		14.59	10.11	0.970		14.34	10.88	0.983	
3	17.45	13.20	0.792		15.60	10.17	0.990		16.05	11.69	0.863		15.54	11.44	0.861		15.04	11.16	0.864	
4	18.54	13.10	0.721		14.00	9.73	0.840		16.70	12.41	0.921		17.17	11.62	1.026		14.98	12.55	1.027	
5	18.06	13.01	0.668		14.91	9.78	0.898		16.87	12.42	0.833		14.89	11.55	0.746		16.26	10.82	0.796	
6	17.83	12.99	0.732		15.95	10.50	0.859		16.70	13.69	0.865		15.30	12.05	0.938		16.29	11.04	0.879	
7	16.88	..	0.730		13.56	..	0.903		17.74	..	0.784		16.08	..	0.907		15.50	..	0.868	
8	18.76	..	0.726		13.50	..	0.890		17.35	..	0.771		15.48	..	0.841		16.51	..	0.772	

FIFTH SEASON, 1875. Mineral Manures as in 1872, 1873, and 1874; but no Farnyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	16.02	11.71	0.749		16.16	11.85	0.751		16.33	11.51	0.814		16.29	12.02	0.840		16.13	11.57	0.780	
2	16.08	11.72	0.784		15.67	11.22	0.687		15.43	10.77	0.863		15.70	10.90	0.770		15.92	11.71	0.793	
3	17.29	12.78	0.671		15.66	11.52	0.720		17.52	12.80	0.675		15.90	11.45	0.652		16.48	12.12	0.641	
4	16.67	12.11	0.773	0.103	16.10	12.06	0.751	0.112	17.07	12.32	0.755		16.56	11.89	0.758	0.125	16.24	11.69	0.775	0.121
5	16.94	12.99	0.686	0.107	16.53	12.09	0.722	0.125	16.55	12.08	0.683	0.122	15.34	11.20	0.682	0.152	15.86	11.81	0.622	0.123
6	18.04	12.66	0.782	0.127	16.78	12.47	0.762	0.123	16.19	12.21	0.752	0.136	16.21	11.58	0.777	0.158	16.53	12.09	0.759	0.141
7	17.51	..	0.730		16.22	..	0.874		16.50	..	0.802		15.83	..	0.856		16.38	..	0.866	
8	16.81	..	0.770		16.01	..	0.812		16.56	..	0.767		15.96	..	0.768		15.86	..	0.658	

(1) Owing to the deficiency of Rain for some time after sowing a large proportion of the plants failed. Some were transplanted on plots 1, but not on the other plots; and eventually the plant was (excepting on plots 1) upon the whole very deficient and irregular, the remaining plants being larger than usual.

EXPERIMENTS ON MANGOLD WURZEL.—BARN FIELD (after SUGAR-BEET); commencing 1876.

The arrangement of the Plots is precisely the same as previously for Sugar-beet, excepting that Plot 9, which was unmanured for Sugar-beet, and also previously for Swedes, is now added as a manured Plot. With this exception, the manures are also substantially the same as previously for Sugar-beet; in fact, precisely the same as for the Sugar-beet in 1872 and 1873. Seed, Yellow Globe; dibbled on ridges, rows 26 inches apart; plants 11 inches apart in the rows (?). Area under experiment about 8 acres. Roots all carted off; Leaves weighed, spread on the respective Plots, and ploughed in.

PLOTS.	MANURES PER ACRE PER ANNUM.											
	SERIES 1.		SERIES 2. As Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.		SERIES 3. As Series 1, and Cross-dressed with 400 lbs. "Ammonia- salts."		SERIES 4. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonia- salts."		SERIES 5. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			
FIRST SEASON, 1876. Seed dibbled, May 22-26. Crop taken up, Nov. 3-17.												
	PRODUCE PER ACRE.											
	Roots.		Leaves.		Roots.		Leaves.		Roots.		Leaves.	
	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .	19 12	4 9	25 2	7 5.	29 19	7 12	31 9	10 5	24 9	5 19	5 19
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (?) ..	19 13	4 6	27 13	7 3	29 8	7 10	30 18	9 16	29 19	6 12	6 12
3	Without Manure (1846, and since) .. .	6 10	1 14	20 13	5 12	14 3	4 10	19 19	7 7	17 4	4 15	4 15
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. . }	8 8	1 15	25 1	6 0	19 19	4 9	30 8	8 13	25 8	5 10	5 10
5	3½ cwt. Superphosphate .. .	7 10	1 14	21 0	5 14	13 10	5 1	17 2	7 14	17 17	5 17	5 17
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potass .. .	6 16	1 12	21 2	5 8	17 15	4 13	28 8	9 0	20 10	5 4	5 4
7	3½ cwt. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (?)	8 13	2 3	22 11	5 14	19 2	5 11	27 2	9 9	20 12	5 15	5 15
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 9	1 10	15 16	5 3	11 17	4 16	18 2	7 11	15 12	4 18	4 18
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (?) .. .	..	..	..	..	25 14	7 6	..	..	..	..	..
SECOND SEASON, 1877. Seed dibbled, June 4-6 (Plots 8 and 9, June 11th). Crop taken up, Nov. 14-23.												
	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .	15 7	2 1	24 13	3 14	27 1	4 4	30 5	5 5	25 18	3 4	3 4
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (?) ..	16 14	1 19	26 8	3 12	26 18	4 6	28 15	5 9	24 12	2 19	2 19
3	Without Manure (1846, and since) .. .	5 9	1 0	16 17	3 14	8 16	3 0	13 9	3 19	13 17	2 10	2 10
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. . }	6 16	1 3	21 10	3 10	16 10	2 2	27 9	3 8	21 14	1 17	1 17
5	3½ cwt. Superphosphate .. .	6 1	0 19	20 5	3 1	12 2	2 10	15 3	3 8	15 3	2 2	2 2
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potass .. .	5 8	0 18	20 19	2 18	15 6	1 16	24 18	3 16	19 3	1 12	1 12
7	3½ cwt. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (?)	7 0	1 3	22 2	3 16	16 13	2 7	25 15	5 0	20 13	2 8	2 8
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3 19	1 3	9 17	5 4	7 4	3 10	11 9	4 11	10 3	3 3	3 3
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (?) .. .	..	..	..	..	13 17	4 0	..	..	..	..	..
THIRD SEASON, 1878. Seed dibbled, June 8-9 (Plot 9, June 11th). Crop taken up, Nov. 7-20.												
	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .	13 5	2 16	18 15	4 4	20 11	5 6	22 4	6 3	17 1	3 13	3 13
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (?) ..	14 16	2 19	21 4	4 15	19 15	5 3	20 18	5 17	18 17	3 15	3 15
3	Without Manure (1846, and since) .. .	3 10	1 4	10 2	2 16	4 7	2 11	6 11	3 7	6 3	2 17	2 17
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. . }	5 9	1 7	18 10	4 6	14 3	2 12	21 2	4 14	15 19	3 2	3 2
5	3½ cwt. Superphosphate .. .	4 14	1 8	14 11	3 18	8 2	3 6	8 4	3 3	8 1	3 6	3 6
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potass .. .	3 18	1 3	15 1	3 7	12 0	2 14	15 3	4 11	12 5	3 3	3 3
7	3½ cwt. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (?)	5 8	1 9	13 18	3 1	11 18	2 18	14 0	4 5	11 19	3 8	3 8
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	2 13	1 4	11 19	4 7	6 13	3 5	6 12	4 10	6 4	3 5	3 5
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (?) .. .	..	..	..	..	15 17	5 9	..	..	..	..	..
FOURTH SEASON, 1879. Seed dibbled, May 13-15. Crop taken up, Nov. 11-20.												
	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .	6 3	1 15	9 8	2 9	12 6	3 11	13 16	3 15	10 14	2 12	2 12
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (?) ..	6 13	1 16	11 11	2 18	11 12	3 9	14 1	3 17	9 18	2 11	2 11
3	Without Manure (1846, and since) .. .	1 12	0 12	4 17	1 19	3 12	2 4	7 17	3 3	6 8	1 17	1 17
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. . }	2 2	0 14	8 13	2 8	7 10	1 15	12 10	2 19	7 7	1 14	1 14
5	3½ cwt. Superphosphate .. .	1 18	0 14	8 5	2 9	5 0	1 16	9 13	3 5	6 11	1 12	1 12
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potass .. .	1 15	0 13	7 16	2 7	6 9	1 12	11 11	3 5	7 17	1 13	1 13
7	3½ cwt. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (?)	1 18	0 14	8 2	2 6	6 7	1 14	11 2	3 6	8 4	2 0	2 0
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	1 3	0 11	5 16	2 7	3 10	1 16	9 2	3 14	6 9	2 5	2 5
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (?) .. .	..	..	..	..	9 7	2 19	..	..	..	..	..
FIFTH SEASON, 1880. Seed dibbled, April 22-23 (Plot 9, April 24th). Crop taken up.												
	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .	..	..	..	..	..	..	..	..	..	..	..
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (?) ..	..	..	..	..	..	..	..	..	..	..	..
3	Without Manure (1846, and since) .. .	..	..	..	..	..	..	..	..	..	..	..
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. . }	..	..	..	..	..	..	..	..	..	..	..
5	3½ cwt. Superphosphate .. .	..	..	..	..	..	..	..	..	..	..	..
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potass .. .	..	..	..	..	..	..	..	..	..	..	..
7	3½ cwt. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (?)	..	..	..	..	..	..	..	..	..	..	..
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	..	..	..	..	..	..	..	..	..	..	..
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (?) .. .	..	..	..	..	..	..	..	..	..	..	..

(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 Muriate of Ammonia of Commerce.
 (3) Plot 9 sown on the flat instead of on ridges; plants ridged up afterwards; rows 22 inches apart, plants 10 inches apart in the rows.

EXPERIMENTS ON MANGOLD WURZEL.—BARN FIELD—continued.

SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS.

As it will be some time before we shall be able to report fully the results obtained, or to be yet obtained, illustrating the influence of different manures, and of different seasons, on the composition of Mangels, an abstract of some of the analytical results, at present at command, is given below. The dry matter, ash, and nitrogen, are of course determined in the roots themselves. The sugar is determined in the expressed juice; and calculated into its percentage in the roots, on the assumption that they contain uniformly 96 per cent. of juice. But, with roots varying so much in character of growth, size, and ripeness, this will not be the case. Nevertheless, the results so calculated, approximately, and usefully, represent both the actual and relative amounts of sugar in the various roots. The amounts of dry matter, ash, and nitrogen, have also, in many cases, been determined in the expressed juice. In many cases also, the amount of the nitrogen existing as albuminoids has been determined (by Church's method). It may be observed that by far the larger proportion of both the mineral matter and the nitrogen of the roots is found in the juice; and of the nitrogen in the juice a variable proportion, ranging from less than one-fifth to not more than one-third of the total, is found to exist as albuminoids.

In interpreting the figures, it must be borne in mind, that, with forty different experiments each year, and, in each year four, or five, or more, times, as much produce on some plots as on others, it would be impossible to sample each at its best, and all in the same condition of ripeness. Each year the seed was sown on all the plots at the same time. The sample analysed was in each case a mixture of vertical sections of ten or fifteen roots, and all the samples were as a rule taken within a period of from one to two weeks; as far as practicable beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones.

For Manures and Produce, see facing page.		CROSS-DRESSED MANURES, PER ACRE, PER ANNUM.																			
		SERIES 1. No cross-dressing.				SERIES 2. As Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.				SERIES 3. As Series 1, and Cross-dressed with 400 lbs. Ammonia-salts.				SERIES 4. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. Ammonia-salts.				SERIES 5. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			
FIRST SEASON, 1876.																					
Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																					
PLOTS.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	12.14	7.14	0.969	10.54	..	1.031	10.65	..	1.080	8.98	..	1.065	11.30	..	..	11.30	..	..	0.989	..	..
2	12.41	7.19	0.943	9.35	4.85	1.020	9.64	5.72	1.018	8.92	..	1.034	10.51	..	..	10.51	..	..	1.005	..	..
3	15.14	..	0.828	11.94	..	0.903	12.16	..	0.904	11.60	..	0.811	12.42	..	..	12.42	..	..	0.751	..	..
4	13.99	8.98	0.905	11.36	6.32	1.013	12.23	7.03	0.989	9.91	5.62	1.067	11.28	6.94	1.003	11.28	6.94	1.003	..	..	..
5	13.51	9.48	0.818	10.99	6.36	0.917	11.73	7.93	0.735	10.93	6.05	0.816	10.65	6.84	0.744	10.65	6.84	0.744	..	..	..
6	13.67	8.74	0.928	11.23	7.67	0.929	11.02	7.41	0.993	10.56	5.40	1.036	11.55	7.30	0.911	11.55	7.30	0.911	..	..	..
7	13.63	..	0.882	11.61	..	0.922	10.62	..	0.969	10.66	..	1.015	11.58	..	0.936	10.66	..	1.015	..	..	..
8	13.06	..	0.900	11.23	..	0.945	11.43	..	0.905	10.20	..	0.856	11.61	..	0.757	10.20	..	0.856	..	..	..
9	..	..	..	..	..	..	11.59	7.80	0.876	..	..	..	..	..	..	..	..	..	..	..	..
SECOND SEASON, 1877.																					
1	14.48	9.04	0.988	12.01	8.21	1.122	12.95	8.95	1.097	12.44	7.97	1.114	13.34	7.79	1.010	12.44	7.97	1.114	13.34	7.79	1.010
2	13.85	10.02	0.961	12.91	8.22	1.107	13.24	7.84	1.089	11.78	7.68	1.126	14.08	8.51	1.000	13.24	7.84	1.089	14.08	8.51	1.000
3	16.58	11.19	0.827	14.06	8.76	1.072	17.11	10.16	0.888	14.44	9.80	0.834	16.41	10.21	0.819	17.11	10.16	0.888	16.41	10.21	0.819
4	15.42	10.92	0.948	12.25	7.26	1.121	13.11	9.35	1.085	12.69	7.51	1.221	13.45	9.81	1.046	13.11	9.35	1.085	13.45	9.81	1.046
5	15.84	11.62	0.797	12.90	8.54	0.889	15.63	10.00	0.838	14.36	8.24	0.786	15.35	10.66	0.784	15.63	10.00	0.838	15.35	10.66	0.784
6	16.15	11.31	0.891	12.53	9.10	1.135	15.05	9.45	1.095	14.27	8.90	1.061	14.10	9.94	0.978	15.05	9.45	1.095	14.27	8.90	1.061
7	15.88	..	0.943	12.74	..	1.034	13.96	..	1.098	12.58	..	1.136	13.83	..	1.036	13.96	..	1.098	12.58	..	1.136
8	16.23	..	0.933	14.01	..	1.023	14.95	..	0.932	14.51	..	0.811	14.87	..	0.807	14.95	..	0.932	14.51	..	0.811
9	..	..	..	..	..	..	14.84	10.01	1.011	..	..	..	..	..	..	..	..	1.011	..	..	..
THIRD SEASON, 1878.																					
1	12.26	7.32	0.995	0.170	11.47	6.36	1.036	0.218	11.17	6.27	1.013	0.206	10.83	5.65	1.046	0.241	11.98	6.90	0.985	0.186	0.186
2	11.51	6.97	0.981	0.182	10.05	5.21	1.072	0.216	11.00	6.08	1.034	0.206	10.30	5.94	0.987	0.217	10.66	6.14	0.948	0.175	0.175
3	15.25	10.20	0.824	0.186	12.02	7.08	0.908	0.211	13.47	8.09	0.811	0.261	12.86	7.61	0.802	0.247	14.10	8.82	0.846	0.240	0.240
4	13.56	9.01	0.928	0.129	11.03	6.24	1.084	0.188	11.90	7.27	0.975	0.144	10.33	5.88	1.027	0.181	11.22	6.53	1.044	0.171	0.171
5	13.91	9.17	0.810	0.144	11.61	6.90	0.873	0.188	13.00	8.14	0.845	0.187	12.69	7.68	0.739	0.244	13.87	8.66	0.786	0.211	0.211
6	14.23	9.12	0.989	0.173	11.04	6.23	0.986	0.193	13.55	8.67	0.988	0.184	12.09	6.96	1.016	0.235	12.18	7.36	0.940	0.197	0.197
7	13.42	..	0.976	..	11.26	..	0.982	..	11.92	..	0.932	..	12.03	..	0.986	..	12.05	..	0.977	..	..
8	14.50	..	0.903	..	11.10	..	0.937	..	12.81	..	0.869	..	11.93	..	0.879	..	12.52	..	0.863	..	..
9	..	..	..	..	..	..	..	..	10.77	6.21	0.939	..	..	..	..	..	..	..	..	..	..
FOURTH SEASON, 1879.																					
1	14.91	9.62	1.007	0.175	13.18	7.97	1.010	0.196	13.86	8.67	1.025	0.193	13.34	8.01	1.025	0.186	14.62	9.19	1.022	0.177	0.177
2	14.78	9.49	1.012	0.185	13.43	8.08	1.016	0.184	13.14	8.07	1.051	0.181	13.34	8.32	1.064	0.186	14.40	9.24	0.995	0.219	0.219
3	18.81	12.50	0.861	0.205	16.01	10.00	0.955	0.226	17.18	11.08	0.834	0.252	16.27	10.44	0.831	0.260	16.16	10.46	0.842	0.203	0.203
4	15.56	10.44	0.980	0.151	12.83	8.10	1.010	0.156	14.03	9.28	0.962	0.134	13.67	8.36	1.086	0.171	13.51	8.62	0.938	0.136	0.136
5	16.53	11.29	0.848	0.159	12.60	7.82	0.951	0.180	15.61	10.43	0.814	0.202	14.84	9.25	0.810	0.220	15.57	10.40	0.840	0.182	0.182
6	16.34	10.97	1.008	0.156	13.75	8.76	0.972	0.180	14.50	9.60	0.998	0.162	13.49	8.47	1.038	0.214	14.42	9.35	0.949	0.157	0.157
7	16.33	..	0.895	..	12.97	..	0.997	..	14.48	..	0.946	..	14.18	..	0.947	..	15.35	..	0.947	..	..
8	18.46	..	0.903	..	13.78	..	0.963	..	15.44	..	0.812	..	14.13	..	0.853	..	15.58	..	0.852	..	..
9	..	..	..	..	..	..	..	..	14.52	9.36	0.930	..	..	..	..	..	..	..	..	..	..
FIFTH SEASON, 1880.																					
1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
8	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

EXPERIMENTS ON POTATOS.—HOOS FIELD; commencing 1876.

The Land had been under experiments with Wheat, differently manured, from 1856 to 1874; and was fallowed in 1875.

Plots 1, 2, 3, and 4 had been unmanured for the Wheat. Plots 5 and 6 had received the same quantity of Ammonia-salts alone every year for the Wheat, as Plot 5 now receives for potatos: Plot 6 now receiving the same amount of nitrogen, but as Nitrate of Soda, instead of Ammonia-salts. Plots 7 and 8 received the same amount of complex mineral manure, and Ammonia-salts, for the Wheat, as Plot 7 now receives for potatos; and Plot 8 now receives the same complex mineral manures, and the same amount of nitrogen, but as Nitrate of Soda instead of Ammonia-salts. Plots 9 and 10 received the same complex mineral manures alone for the Wheat as Plot 10 now receives for potatos; Plot 9 now receives superphosphate only (*). Description of Potatos, in 1876, 1877, 1878, and 1879, the "Rock;" and in those years the rows were 25 inches apart; with 12 inches from plant to plant in the rows. In 1880, the description was the "Champion;" and the rows were 25 inches apart; with 14 inches from plant to plant in the rows.

PLOTS.	MANURES PER ACRE PER ANNUM.	PRODUCE PER ACRE.				
		Tubers.				Tops.
		Good.	Small.	Diseased.	TOTAL.	

FIRST SEASON, 1876. Potatos planted, June 10-13; Crop taken up, Oct. 30-31.

		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	
1	Unmanured	3 6½	0 5½	0 5½	3 17½	Withered, not weighed, each lot spread on its own Plot and ploughed in.
2	Farmyard Manure (14 tons) .. .	3 18½	0 4	0 3½	4 5½	
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (*) .. .	4 14½	0 0½	0 5½	5 6½	
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda .. .	5 9½	0 5½	0 19½	6 14½	
5	400 lbs. Ammonia-salts (*) .. .	2 5½	0 6½	0 6	2 18	
6	550 lbs. Nitrate of Soda .. .	3 2	0 5½	0 9½	3 17½	
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	6 12½	0 9½	1 0	8 2	
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	6 17½	0 10	1 8½	8 15½	
9	3½ cwt. Superphosphate .. .	4 18½	0 8½	0 13½	6 1	
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia .. .	5 3½	0 6½	0 13½	6 3½	

SECOND SEASON, 1877. Potatos planted, April, 27-28; Crop taken up, Oct. 8-10.

		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	
1	Unmanured	2 11½	0 6½	0 2½	3 0½	Withered, not weighed, each lot spread on its own Plot, but high wind (Oct. 14th) blew all off, before ploughing.
2	Farmyard Manure (14 tons) .. .	5 0½	0 11½	0 6	5 18	
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (*) .. .	4 19½	0 7½	0 4	5 4½	
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda .. .	6 18½	0 7	0 17½	8 3½	
5	400 lbs. Ammonia-salts (*) .. .	3 9½	0 7½	0 4	4 1	
6	550 lbs. Nitrate of Soda .. .	4 14½	0 6½	0 5½	5 7½	
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	6 12	0 11½	0 14½	7 17½	
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	7 8½	0 8½	0 16½	8 13½	
9	3½ cwt. Superphosphate .. .	2 12½	0 11½	0 1½	3 6	
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia .. .	3 6½	0 7½	0 1½	3 15½	

THIRD SEASON, 1878. Potatos planted, April 29. Crop taken up, Sept. 18-21; Tops weighed, and spread on the Plots.

		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Unmanured	2 6½	0 8½	0 2	2 17½	0 3½
2	Farmyard Manure (14 tons) .. .	4 11	0 12½	0 8½	5 11½	0 6½
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (*) .. .	5 18½	0 14½	0 13½	7 6	0 11
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda .. .	6 11½	0 11½	1 6½	8 9½	1 6
5	400 lbs. Ammonia-salts (*) .. .	2 16½	0 8½	0 5½	3 10½	0 7
6	550 lbs. Nitrate of Soda .. .	3 16½	0 7	0 9½	4 13½	0 11
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	7 6½	0 9½	1 1	8 17½	0 13½
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	7 11½	0 9	1 3½	9 4½	1 0½
9	3½ cwt. Superphosphate .. .	3 5½	0 9½	0 3½	3 18½	0 4½
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia .. .	3 8	0 9	0 4½	4 1½	0 4½

FOURTH SEASON, 1879. Potatos planted, May 2; Crop taken up, Oct. 13-16.

		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	
1	Unmanured	0 11½	0 4	0 0½	0 16½	Withered, not weighed, each lot spread on its own Plot and ploughed in.
2	Farmyard Manure (14 tons) .. .	1 13½	0 4½	0 10½	2 8½	
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (*) .. .	1 14	0 6	0 10½	2 10½	
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda .. .	2 16	0 5½	0 12½	3 14½	
5	400 lbs. Ammonia-salts (*) .. .	0 17½	0 4	0 1½	1 3	
6	550 lbs. Nitrate of Soda .. .	0 14½	0 4½	0 2	1 0½	
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	2 4½	0 5	0 6	2 15½	
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .	1 18½	0 4½	0 6½	2 9	
9	3½ cwt. Superphosphate .. .	0 17½	0 3½	0 1½	1 2	
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia .. .	0 16½	0 3	0 1½	1 1½	

FIFTH SEASON, 1880. Potatos planted, April 13; Crop taken up.

		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Unmanured					
2	Farmyard Manure (14 tons) .. .					
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (*) .. .					
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda .. .					
5	400 lbs. Ammonia-salts (*) .. .					
6	550 lbs. Nitrate of Soda .. .					
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .					
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag. .. .					
9	3½ cwt. Superphosphate .. .					
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia .. .					

(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 Muriate Ammonia of Commerce.

(3) The complex mineral manure having been sown in October, 1874, but the Wheat not put in, and therefore no crop taken in 1875, no mineral manures are sown afresh on Plots 7, 8, 9, and 10, for the first crop of potatos, 1876.

EXPERIMENTS ON POTATOS.—HOOS FIELD—continued.

SUMMARY OF THE COMPOSITION OF THE "GOOD" TUBERS.

As it will be some time before we shall be able to report fully the results obtained, or to be yet obtained, illustrating the influence of different manures, and of different seasons, on the composition of Potatos, an abstract of some of the analytical results at present at command is given below. The specific gravity of the tubers is also given. Besides the results obtained relating to the composition of the tubers themselves, the dry matter, the sugar, the ash, and the nitrogen in the expressed juice has in many cases been determined. It may be remarked, that by far the larger proportion of both the mineral matter, and the nitrogen, is found to exist in the juice; and of the nitrogen in the juice as a rule, not much more than half exists as albuminoids. In the majority of cases, the small potatoes have been submitted to the same methods of analysis as the good potatoes. And in a large number of cases, similar methods of examination have been applied to the still white, and also to the separated discoloured portions of the diseased potatoes. With regard to these latter results, it may be observed, that whilst the juice of the white portion of the diseased potatoes contained approximately the normal amount of nitrogen, that of the discoloured portion contained very much less. On the other hand, the washed, or exhausted "mark" of the white portion, contained very little nitrogen, whilst that of the discoloured portion contained very much more. The distribution of the mineral matter was much in the same order as that of the nitrogen. It was obvious that the juice had suffered exhaustion of much of both its nitrogen and its mineral matter, in the development of the fungus. There was an increased amount of the results given in the Table relate to the "good" potatoes only. In interpreting the figures it must be borne in mind that in each year, the seed was planted on all the plots at the same time, and that all the crops were taken up at the same time; and as there was several times as much produce in some cases as in others, it is obvious that the crops would not each be at its best, and all in the same condition of maturity, when taken up. Then, again, the analyses were not performed immediately after taking up the crops, but after weighed samples had been kept in a cool place for some weeks or months; and in the following only preliminary statement of results, no correction is made for any change from the original weight of the samples, the results being calculated upon the fresh weights as finally taken for analysis.

PLOTS.	MANURES PER ACRE, PER ANNUM. (For Produce, see facing page.)	Specific Gravity of the Tubers.	Composition of the "Good" Tubers.				
			Dry Matter.	Mineral Matter (Ash).		Nitrogen.	
				In Fresh Tubers.	In Dry Matter.	In Fresh Tubers.	In Dry Matter.
FIRST SEASON, 1876.							
1	Unmanured	1.097	Per cent. 23.9	Per cent. 0.84	Per cent. 3.53	Per cent. 0.273	Per cent. 1.14
2	Farmyard Manure (14 tons)	1.091	23.4	0.96	4.11	0.226	0.97
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	1.097	23.5	1.00	4.27	0.193	0.83
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda	1.085	21.2	0.83	3.92	0.239	1.41
5	400 lbs. Ammonia-salts (²)	1.087	22.1	0.81	3.67	0.337	1.52
6	550 lbs. Nitrate of Soda	1.091	22.0	0.79	3.59	0.332	1.51
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.090	20.9	0.98	4.71	0.270	1.29
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.088	21.9	0.98	4.46	0.296	1.35
9	3½ cwt. Superphosphate	1.103	23.5	1.10	4.72	0.201	0.86
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	1.102	22.9	1.06	4.64	0.173	0.76
SECOND SEASON, 1877.							
1	Unmanured	1.119	Per cent. 33.0	Per cent. 1.05	Per cent. 3.17	Per cent. 0.302	Per cent. 0.91
2	Farmyard Manure (14 tons)	1.109	26.5	1.06	4.00	0.212	0.80
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	1.103	26.0	1.11	4.26	0.207	0.80
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda	1.112	27.2	1.06	3.90	0.301	1.11
5	400 lbs. Ammonia-salts (²)	1.107	22.0	0.67	3.07	0.281	1.28
6	550 lbs. Nitrate of Soda	1.116	25.9	0.74	2.85	0.301	1.16
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.103	28.4	1.23	4.33	0.270	0.95
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.112	27.3	1.16	4.26	0.268	0.98
9	3½ cwt. Superphosphate	1.109	26.5	1.18	4.44	0.203	0.76
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	1.109	26.8	1.21	4.52	0.208	0.78
THIRD SEASON, 1878.							
1	Unmanured	1.107	Per cent. 26.0	Per cent. 0.85	Per cent. 3.26	Per cent. 0.228	Per cent. 0.88
2	Farmyard Manure (14 tons)	1.100	24.4	1.02	4.20	0.209	0.86
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	1.090	23.8	1.03	4.35	0.205	0.86
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda	1.078	21.9	0.97	4.45	0.269	1.23
5	400 lbs. Ammonia-salts (²)	1.099	24.9	0.78	3.12	0.310	1.25
6	550 lbs. Nitrate of Soda	1.105	25.5	0.67	2.64	0.326	1.28
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.093	23.6	1.08	4.57	0.223	0.95
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.097	24.4	1.08	4.41	0.228	0.94
9	3½ cwt. Superphosphate	1.097	24.1	1.14	4.74	0.165	0.68
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	1.098	23.7	1.16	4.90	0.167	0.71
FOURTH SEASON, 1879.							
1	Unmanured	1.103	Per cent. 24.3	Per cent. 0.96	Per cent. 3.95	Per cent. 0.242	Per cent. 0.90
2	Farmyard Manure (14 tons)	1.103	23.7	0.99	4.16	0.220	0.93
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	1.099	24.0	1.02	4.26	0.218	0.91
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda	1.102	24.6	0.91	3.69	0.254	1.04
5	400 lbs. Ammonia-salts (²)	1.103	24.6	0.76	3.08	0.270	1.10
6	550 lbs. Nitrate of Soda	1.104	25.0	0.76	3.05	0.300	1.20
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.098	23.1	0.95	4.13	0.241	1.05
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1.102	23.9	1.04	4.36	0.272	1.14
9	3½ cwt. Superphosphate	1.099	23.6	1.10	4.65	0.219	0.93
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	1.099	23.5	1.15	4.89	0.211	0.90
FIFTH SEASON, 1880.							
1	Unmanured		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
2	Farmyard Manure (14 tons)						
3	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)						
4	Farmyard Manure (14 tons), 3½ cwt. Superphosphate, and 550 lbs. Nitrate of Soda						
5	400 lbs. Ammonia-salts (²)						
6	550 lbs. Nitrate of Soda						
7	400 lbs. Ammonia-salts, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.						
8	550 lbs. Nitrate of Soda, 3½ cwt. Superphos., 300 lbs. Sulph. Potass., 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.						
9	3½ cwt. Superphosphate						
10	3½ cwt. Superphosphate, 300 lbs. Sulphate Potass., 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia						

(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 Muriate 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 (1880) is the 33rd experimental one, or the first crop of the Ninth 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, and Fourth Courses, clover was sown, but failed; and in them, and in the Fifth and Sixth Courses, beans were taken instead, on half of each plot, 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, and gave three cuttings; the other half of each being left fallow. In the eighth course beans were again grown. 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, sixth, and eighth 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, alone, for the Turnip Crops only.			Plot 3. Complex Manure, 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.	225½ cwt.	106½ cwt.	332	218	151½	369½
1849	Barley	44½ bush.	2963 lbs.	5656 lbs.	29½ bush.	2111 lbs.	3841 lbs.	2088 lbs.	3794 lbs.	63 cwt.
1850	Clover (calc. as hay)	..	..	54 cwt.	..	57½ cwt.	..	..	..	..
1851	Wheat	28½ bush.	3431 lbs.	5389 lbs.	28 bush.	3371 lbs.	5233 lbs.	28½ bush.	3592 lbs.	4500 lbs.
2ND COURSE, 1852-55.										
1852	Swedish Turnips	26 cwt.	44 cwt.	30½ cwt.	223½ cwt.	20½ cwt.	243½ cwt.	396½ cwt.	36½ cwt.	433 cwt.
1853	Barley	34½ bush.	2430 lbs.	4465 lbs.	28½ bush.	1873 lbs.	3976 lbs.	48 bush.	2604 lbs.	4873 lbs.
1854	Beans	5½ bush.	1065 lbs.	1445 lbs.	5½ bush.	1103 lbs.	1534 lbs.	9½ bush.	1355 lbs.	2065 lbs.
1855	Wheat	33½ bush.	3619 lbs.	3859 lbs.	35½ bush.	3593 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.	147½ cwt.	333½ cwt.	12½ cwt.	346½ cwt.
1857	Barley	48½ bush.	2600 lbs.	5337 lbs.	28½ bush.	1475 lbs.	3076 lbs.	48 bush.	2435 lbs.	5165 lbs.
1858	Beans	6½ bush.	1100 lbs.	1515 lbs.	6½ bush.	1155 lbs.	1605 lbs.	12½ bush.	1530 lbs.	2357 lbs.
1859	Wheat	35½ bush.	4030 lbs.	6262 lbs.	34½ bush.	3930 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.	30½ cwt.	87½ cwt.	5½ cwt.	90½ cwt.
1861	Barley	38½ bush.	2322 lbs.	4718 lbs.	304 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.	48½ bush.	3280 lbs.	5990 lbs.
1863	Wheat	44½ bush.	3467 lbs.	6350 lbs.	34½ bush.	3390 lbs.	5619 lbs.	46½ bush.	4397 lbs.	7626 lbs.
5TH COURSE, 1864-67.										
1864	Swedish Turnips	8½ cwt.	0½ cwt.	9½ cwt.	63 cwt.	4½ cwt.	72½ cwt.	176½ cwt.	8½ cwt.	185 cwt.
1865	Barley	39 bush.	2154 lbs.	4182 lbs.	33½ bush.	1615 lbs.	3394 lbs.	4½ bush.	2355 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.	23½ bush.	3003 lbs.	4367 lbs.
6TH COURSE, 1868-71.										
1868	Swedish Turnips	24½ bush.	Failed, and ploughed up.	3358 lbs.	28½ bush.	Failed, and ploughed up.	3686 lbs.	42½ bush.	Failed, and ploughed up.	5800 lbs.
1869	Barley	13½ bush.	1948 lbs.	1591 lbs.	15½ bush.	2025 lbs.	769 lbs.	24½ bush.	3309 lbs.	2664 lbs.
1870	Beans	20½ bush.	738 lbs.	1591 lbs.	23½ bush.	3049 lbs.	4521 lbs.	23 bush.	1056 lbs.	4883 lbs.
1871	Wheat	20½ bush.	2799 lbs.	4092 lbs.	23½ bush.	3049 lbs.	4521 lbs.	23 bush.	3440 lbs.	4883 lbs.
7TH COURSE, 1872-75.										
1872	Swedish Turnips	34½ cwt.	8½ cwt.	42½ cwt.	1704 cwt.	17½ cwt.	188 cwt.	339½ cwt.	55½ cwt.	375½ cwt.
1873	Barley	23½ bush.	1343 lbs.	2717 lbs.	204 bush.	1565 lbs.	2875 lbs.	31½ bush.	1723 lbs.	3573 lbs.
1874	Clover	..	..	31½ cwt.	..	..	52½ cwt.	..	..	84½ cwt.
1875	Wheat	21½ bush.	2430 lbs.	3784 lbs.	28½ bush.	3536 lbs.	5328 lbs.	31½ bush.	4685 lbs.	6699 lbs.
8TH COURSE, 1876-79.										
1876	Swedish Turnips	17½ cwt.	5 cwt.	22½ cwt.	184 cwt.	284 cwt.	216½ cwt.	356 cwt.	55½ cwt.	411½ cwt.
1877	Barley	22½ bush.	1291 lbs.	2623 lbs.	244 bush.	1174 lbs.	2558 lbs.	34½ bush.	1913 lbs.	3890 lbs.
1878	Beans	8½ bush.	740 lbs.	1301 lbs.	74 bush.	1045 lbs.	1587 lbs.	204 bush.	1655 lbs.	2983 lbs.
1879	Wheat	10½ bush.	1324 lbs.	1987 lbs.	14½ bush.	1771 lbs.	2729 lbs.	13 bush.	1658 lbs.	2493 lbs.
9TH COURSE, 1880-83.										
1880	Swedish Turnips	..	..	..	..	..	..	..	..	..
1881	Barley	..	..	..	..	..	..	..	..	..
1882	Clover or Beans	..	..	..	..	..	..	..	..	..
1883	Wheat	..	..	..	..	..	..	..	..	..

SUMMARY—AVERAGE OF THE FIRST 8 COURSES, 1848-1879.

Years	Crop	Plot 1	Plot 2	Plot 3	Total	Plot 1	Plot 2	Plot 3	Total	
1848, '52, '56, '60, '64, '72, '76, '80, '84, '88	Swedish Turnips	26½ cwt.	9½ cwt.	36½ cwt.	148½ cwt.	264 cwt.	176½ cwt.	272½ cwt.	43½ cwt.	316½ cwt.
	Barley	34½ bush.	2159 lbs.	4132 lbs.	28½ bush.	1730 lbs.	3346 lbs.	41½ bush.	2577 lbs.	4955 lbs.
	Clover, 1850 and '74 (calc. as hay)	..	..	42½ cwt.	..	..	..	..	..	73½ cwt.
	Beans	12½ bush.	1081 lbs.	1887 lbs.	12½ bush.	1200 lbs.	1996 lbs.	21½ bush.	1809 lbs.	3230 lbs.
	Wheat	27½ bush.	2905 lbs.	4649 lbs.	27½ bush.	3067 lbs.	4823 lbs.	30½ bush.	3698 lbs.	5662 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, Seventh, Eighth, and Ninth 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. Sulphate of Soda, 100 lbs. Rape-cake; Second Course—300 lbs. Sulphate of Potass, 100 lbs. Sulphate of Soda, 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, Straw, and Chaff.

EXPERIMENTS WITH DIFFERENT DESCRIPTIONS OF WHEAT, IN 1880, AND SUMMARY OF RESULTS OBTAINED IN PREVIOUS YEARS.

Season 1880.	1871;	1872;	1873;	1874;	1875;	1876;	1877;	1878;	1879; (C)	1880;	1881;	1882;	Averages, up to 1878 inclusive.	Nos.
Harpenden Field, 50 Bushels of Soot; after Clover; Unmanured. One Crop, as Hay; afterwards Fed.	Sawpit Field; 3 cwt. Guano; after Mangolds, carted off.	Foster's Field; 2 cwt. Super-phosphate, 2 cwt. Soda; after Hoops, carted off.	Long Hoop Field; 1½ cwt. Nitrate; after Mangolds (with Dung), carted off.	Upper Harpenden Field; 2 cwt. Nitrate; after Mangolds (with Dung), carted off.	Little Knot-Field; 1½ cwt. Nitrate; after Mangolds (with Dung), 1874, carted off.	Harpenden Field; 2 cwt. Nitrate; after Mangolds (with Dung), 1876, carted off.	Sawpit Field; 1½ cwt. Nitrate; after Mangolds (with Dung), 1876, carted off.	Foster's Field; 2 cwt. Nitrate; after Turnips (with Dung and Artificial) 1877, part Fed, afterwards Fed.	Little Knot-Field; 2 cwt. Nitrate; after Clover, First and second Crops, as Hay; afterwards Fed.	Harpenden Field; 50 cwt. Nitrate; after Clover; One Crop as Hay; afterwards Fed.				
1. White-chaff (Red) .. .. .	.. .. .	.. .. .	40½	55½	40½	49½	48½	59	22½	.. .. .	.. .. .	.. .. .	48½	1
2. Rivett's (Red) .. .. .	.. .. .	.. .. .	48½	67	48½	49½	49½	66½	16	.. .. .	.. .. .	.. .. .	53½	2
3. Chubb Wheat (Red)	28½	40	35½	50½	38½	40½	41½	55½	20½	.. .. .	.. .. .	.. .. .	41½	3
4. Red-chaff (White)	32½	57	35½	48½	34½	43½	41	.. .. .	24	.. .. .	.. .. .	.. .. .	39	4
5. Brownick (Red)	31½	40½	38½	51½	38½	39	40½	49½	22	.. .. .	.. .. .	.. .. .	41½	5
6. Red Wonder	31½	43½	37½	55½	38½	44½	41½	52½	27	.. .. .	.. .. .	.. .. .	42½	6
7. Burwell (Old Red Lammas)	29½	41½	35½	47½	38½	39	40½	53	21½	.. .. .	.. .. .	.. .. .	39½	7
8. Bristol Red	34½	44½	39½	47½	39	42½	40½	52½	30½	.. .. .	.. .. .	.. .. .	42½	8
9. Red Nursery	30½	45½	34½	47½	39	42½	40½	50½	25½	.. .. .	.. .. .	.. .. .	41½	9
10. Red Langham	31½	43½	37	46½	37	40½	42½	54	20	.. .. .	.. .. .	.. .. .	41½	10
11. Woolly Ear (White) .. .. .	.. .. .	.. .. .	42	49	33½	44	42½	54	21½	.. .. .	.. .. .	.. .. .	44½	11
12. Hardcastle (White)	39½	46½	44	51½	38½	44	42½	52½	21	.. .. .	.. .. .	.. .. .	46½	12
13. Golden Drop (Red), Hallett's	33½	45½	38½	51½	38½	41	42½	52½	17½	.. .. .	.. .. .	.. .. .	40½	13
14. Victoria White, Hallett's	26½	35½	35½	44½	33½	41	42½	43½	14	.. .. .	.. .. .	.. .. .	40½	14
15. Hunter's White, Hallett's	30	38½	36½	45½	36½	40½	43	42½	17	.. .. .	.. .. .	.. .. .	37½	15
16. Original Red, Hallett's	38½	45½	38½	42	43	40½	44	49	11	.. .. .	.. .. .	.. .. .	36½	16
17. White Chidlam	37	46½	40	53½	37	45½	43	57	18	.. .. .	.. .. .	.. .. .	45½	17
18. Red Rostock .. .. .	.. .. .	.. .. .	46	52	32½	40	37½	46	15	.. .. .	.. .. .	.. .. .	45½	18
19. Casey's White	37	44	37	52	39	45½	43	57	19	.. .. .	.. .. .	.. .. .	44	19
20. Golden Rough-chaff (Red)	33	42½	38	52	38	46	44	52	31	.. .. .	.. .. .	.. .. .	44	20
21. Bole's Prolife (Red)	33½	45½	45	48	43	41	44	52	31	.. .. .	.. .. .	.. .. .	44	21
22. Club Wheat (Red)	36	45½	47½	59	46	47	49	61	23	.. .. .	.. .. .	.. .. .	50½	22
23. Main's Standing White .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	50	24	.. .. .	.. .. .	.. .. .	50	23
24. Main's Rough-chaff (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	50	24	.. .. .	.. .. .	.. .. .	50	24
25. Belgian (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	52	21	.. .. .	.. .. .	.. .. .	52	25
26. Webb's Challenge (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	52	21	.. .. .	.. .. .	.. .. .	52	25
Means	32½	42½	38½	50½	36½	42½	42½	51½	21½	.. .. .	.. .. .	.. .. .	49½	Means.

DRESSED CORN PER ACRE. Bushels.

WEIGHT PER BUSHEL. Lbs.

1. White-chaff (Red)	61	63	60½	60½	60½	60½	60½	60½	51½	61	58½	61	61	1
2. Rivett's (Red)	58½	59	60½	60½	60½	60½	60½	60½	59	58½	60½	60½	58½	2
3. Chubb Wheat (Red)	61	61	60½	60½	60½	60½	60½	60½	53	60½	60½	60½	60½	3
4. Red-chaff (White)	60½	60½	60½	60½	60½	60½	60½	60½	.. .. .	60½	60½	60½	60½	4
5. Brownick (Red)	60	60	60	60	60	60	60	60	52½	60	60	60	60	5
6. Red Wonder	59	60	60	60	60	60	60	60	52	60	60	60	60	6
7. Burwell (Old Red Lammas)	62	63	61½	63	61½	61½	61½	61½	55½	61½	61½	61½	61½	7
8. Bristol Red	60½	61	60½	60½	60½	60½	60½	60½	57	60½	60½	60½	60½	8
9. Red Nursery	63	65	62	62	62	62	62	62	54	62	62	62	62	9
10. Red Langham	60½	61	60½	60½	60½	60½	60½	60½	54	60½	60½	60½	60½	10
11. Woolly Ear (White)	61	62	61	61	61	61	61	61	52	61	61	61	61	11
12. Hardcastle (White)	61	63	61	61	61	61	61	61	52	61	61	61	61	12
13. Golden Drop (Red), Hallett's	61	63	61	61	61	61	61	61	52	61	61	61	61	13
14. Victoria White, Hallett's	61	63	61	61	61	61	61	61	55	61	61	61	61	14
15. Hunter's White, Hallett's	61	63	61	61	61	61	61	61	55	61	61	61	61	15
16. Original Red, Hallett's	60	60	60	60	60	60	60	60	55	60	60	60	60	16
17. White Chidlam	62	63	61½	63	61½	61½	61½	61½	54	61½	61½	61½	61½	17
18. Red Rostock	60½	61	60½	60½	60½	60½	60½	60½	54	60½	60½	60½	60½	18
19. Casey's White	60	60	60	60	60	60	60	60	54	60	60	60	60	19
20. Golden Rough-chaff (Red)	61	62	61	61	61	61	61	61	55	61	61	61	61	20
21. Bole's Prolife (Red)	61	62	61	61	61	61	61	61	54	61	61	61	61	21
22. Club Wheat (Red)	60	61	60	60	60	60	60	60	54	60	60	60	60	22
23. Main's Standing White .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	56	.. .. .	.. .. .	.. .. .	61	23
24. Main's Rough-chaff (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	56	.. .. .	.. .. .	.. .. .	61	24
25. Belgian (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	53	.. .. .	.. .. .	.. .. .	61	25
26. Webb's Challenge (White) .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	53	.. .. .	.. .. .	.. .. .	61	25
Means	60½	62½	59½	61½	60½	63½	60½	62	53	.. .. .	.. .. .	.. .. .	61	Means.

(*) All the crops were more or less affected by wire-worm, large bare patches appearing on many plots; and much grain was immature and blighted.

ROTHAMSTED

MAY,

SUMMARY STATEMENT OF THE PRESENT AND PREVIOUS

(13 Years, 1868-1880,

PREVIOUS CROPPING

Name of Field.	Acres.	PREVIOUS CROPPING						
		1868.	1869.	1870.	1871.	1872.	1873.	1874.
Thirty Acres	30	Clover.	Wheat, 2 cwt. Guano.	Oats, 2 cwt. Guano.	Barley, 2 cwt. superphos., 2 cwt. Nitrate Soda.	Barley, 2½ cwt. superphos., 2½ cwt. Nitr. Soda, (2½ acres experiment.)	Barley (¾ with Grass-seeds), 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Grass (¾), Folded, and 1 cwt. Nitrate. Barley (¼), 2 cwt. superphosphate, 2½ cwt. Nitrate Soda.
Harpenden	22	Oats, 2 cwt. Guano, & 1 cwt. Nitr. Soda. ¼ rd { ¼ rd { and Sheep-folded.	Sweedes, Dung and various Artificial Manures.	Wheat, 3 cwt. Guano.	Oats, 3 cwt. Guano, 1 cwt. Nitrate Soda.	Oats, 2½ cwt. superphos., 2½ cwt. Nitr. Soda. Tares, Dung.	Barley, After Oats—2 cwt. super- phosphate; 2 cwt. Nitrate. After Tares—1 cwt. super- phosphate; 1 cwt. Nitrate.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.
Little Hoos	9	Oats, 2 cwt. Guano, 1 cwt. Nitrate of Soda.	Barley, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia, 1 cwt. superphosphate.	Barley, 2½ cwt. Guano.	Barley, 3 cwt. superphos., 2½ cwt. Nitrate Soda.	Barley (with Clover). 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Barley (¼), Unmanured. Clover (¾), Unmanured.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda (1 acre Unmanured).
Fosters'	18	Oats, 2 cwt. Guano, 1 cwt. Nitrate of Soda.	Barley, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia, 1 cwt. superphosphate.	Oats, 2 cwt. Guano, 3 cwt. Blood Manure.	Roots, Tares, and Rape, Dung and Artificial.	Wheat, ¼ Varieties of Wheat, 2 cwt. superphos., 2 cwt. Nitr. Soda, ¾ Sheep-folded.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda (2 acres experiment).	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.
Knott Wood	30	Sweedes, 2 cwt. Guano, 2½ cwt. superphosphate and Dung.	Wheat, 3 cwt. Guano (one-half), Unmanured (one-half), after Sweedes ploughed up and Fallowed.	Oats, 3 cwt. Guano.	Oats, 3 cwt. Guano, 1 cwt. Nitrate Soda.	Oats, 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Tares (¾), Dung. Sweedes (¼), Dung, 2 cwt. superphosph.; 2 cwt. Nitrate Soda.	Barley, After Roots and Tares carted, 2 cwt. superphosphate, 2 cwt. Nitrate Soda, After Tares fed, 1 cwt. each.
Little Knott Wood ..	14	Oats, 2 cwt. Guano, 1 cwt. Nitrate Soda.	Mangolds, 12 tons Dung, 3 cwt. Guano.	Wheat, 3 cwt. Guano.	Oats, 3 cwt. Guano, 1 cwt. Nitrate Soda.	Oats, ¾ Sheep-folded. All, 2½ cwt. super., 2½ cwt. Nitr. Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Mangolds, Dung. (Carted off)
Sawpit ..	14	Wheat, 1 cwt. Guano, 1 cwt. Wheat Manure.	Wheat, 3 cwt. Guano.	Mangolds, Dung and, 3 cwt. Guano.	Wheat, 3 cwt. Guano.	Oats, 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Oats, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.
Rick-yard	8	Barley, 2 cwt. Wheat Manure.	Tares, Dung.	Barley, 1 cwt. Guano.	Mangolds, Dung and 4 cwt. Cotton Cake.	Wheat, Unmanured.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Tares, Dung. ½ followed by Turnips, 1 cwt. superphosphate, 1 cwt. Nitrate Soda.
Six Acres ..	6	Beans, Dung.	Wheat, 2 cwt. Guano, 1 cwt. Nitrate of Soda.	Barley, 2½ cwt. Guano.	Barley, 3 cwt. superphos., 2½ cwt. Nitrate Soda.	Barley, 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2½ cwt. Nitrate Soda.
Clay-Croft	12	Wheat, 2 cwt. Guano.	Oats, 2 cwt. Guano, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia.	Turnips, Dung and 3 cwt. super- phosphate.	Wheat, Unmanured.	Oats, 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Clover, Unmanured.	Wheat, 2 cwt. Nitrate Soda.
Ten Acres ..	10	Red Clover.	Wheat, 2 cwt. Guano.	Oats, 3 cwt. Guano.	Mangolds, Dung and 4 cwt. Cotton Cake.	Wheat, Unmanured.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda (5 acres experiment).	Oats, 2 cwt. superphosphate, 2½ cwt. Nitrate Soda.
Agdell ..	9	Tares, Dung.	Barley, Unmanured.	Barley, 1½ cwt. Guano, 1½ cwt. super- phosphate.	Mangolds, Dung and 4 cwt. Cotton Cake.	Wheat, Unmanured (and part Roots).	Clover, Unmanured. Barley, Experiment.	Wheat, 1 cwt. Nitrate Soda (3 acres Experiment, ½ Clover, ½ Fallow).
Long Hoos	25	Wheat, 1 cwt. Guano.	Oats, 2 cwt. Guano, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia.	Sainfoin, Unmanured.	Sainfoin, Unmanured. (Steam cultivated, July.)	Mangolds, Dung. (Carted off.)	Wheat, (¼ Varieties of Wheat), 1½ cwt. Nitrate Soda.	Oats, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.
Sawyers' ..	25	Wheat, 3 cwt. Guano.	Fallow.	Wheat, 4 cwt. Guano.	Wheat, 4 cwt. Guano, 1 cwt. Nitrate Soda.	Barley, 2½ cwt. superphos., 2½ cwt. Nitr. Soda.	Oats, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Mangolds and Sweedes, Dung.
West Barn	30	Fallow.	Wheat, 3 cwt. Guano.	Sainfoin, Unmanured.	Sainfoin, Unmanured.	Sainfoin, Unmanured.	Oats, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Wheat (Oats fed off 1873), 1½ cwt. Nitrate Soda.

FARM.

1880.

CROPPING, &c., OF THE ARABLE LAND NOT UNDER EXPERIMENT.
(inclusive.)

AND MANURING.

1875.	1876.	1877.	1878.	1879.	Crops, &c., Present Season, 1879-'80.	Acres.	Name of Field.
Grass (3/4), Sheep-folded. Tares (1/2) Dung.	Grass (3/4). Compost. Wheat (1/2). 1 cwt. Nitrate Soda.	Grass (3/4). Cattle Grazed. Barley (1/2). 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Grass (3/4). Cattle Grazed with Cotton-Cake. Tares (1/2). Dung.	Grass (3/4). Cattle Grazed with Cotton-Cake. Barley (1/2). 2 cwt. surphosphate, 2 cwt. Nitrate Soda.	Grass (3/4). Cattle Grazed with Cotton-Cake. Barley (1/2). Fallow (1/2).	30	Thirty Acres
Mangolds, Dung, and 2 cwt. Guano. (Carted off.)	Wheat (Varieties). 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley (with Clover), 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Clover. Unmanured. One Crop as Hay.	Wheat (1/2), (Varieties). 50 bushels Soot. Mangolds (1/2), 15 tons Dung & 3 cwt. Guano.		22	Harpenden.
Barley, where Barley 1873, 2 cwt. superphosphate, 2 cwt. Nitrate of Soda, where Clover 1873, Half quantities.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda (1/2 with Clover).	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda (1/2 with Clover).	Barley (1/2). 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda. Clover (1/2). Unmanured. Two Crops as Hay.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. Guano.	9	Little Hoos.
Barley. (1) 3/4 cwt. Guano, (2) 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda, (3) 1 1/2 cwt. Guano, 1 1/2 Nitrate.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	White Turnips, Dung. Superphosphate, 1/2 cwt. Nitrate Soda; part fed, part carted.	Wheat (Varieties). 2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. Guano.	18	Fosters'.
Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Oats, 2 1/2 cwt. superphosphate, 3 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Roots (1/2). Dung and Artificial. (Carted off). Fallow (1/2).	Wheat (1/2). 2 cwt. Nitrate Soda. Barley (1/2). 2 cwt. superphosphate, 2 cwt. Nitrate Soda (all with Clover).	Barley (1/2), 2 1/2 cwt. Guano. Clover (1/2), Unmanured.	9	Knott Wood.
Wheat (Varieties). 1 1/2 cwt. Nitrate Soda.	Oats, 2 1/2 cwt. superphosphate, 3 cwt. Nitrate Soda.	Oats (with Clover). 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Clover, Unmanured. First and second Crops as Hay; afterwards fed.	Wheat (Varieties). 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. Guano.	14	Little Knott Wood.
Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Mangolds, 25 tons Dung. (Carted off.)	Wheat (Varieties). 1 1/2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Fallow.	14	Sawpit.
Barley, 1 cwt. Nitrate Soda.	Swedes, Dung, and Superphosphate.	Barley, 1 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley (1/2). 2 cwt. superphosphate, 2 cwt. Nitrate Soda. Fallow (1/2).	Mangolds, 15 tons Dung, 3 cwt. Guano.	8	Rick-yard.
Barley, 2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley (with Clover). 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Clover, Unmanured. Two Crops as Hay.	Wheat, 2 cwt. Nitrate Soda.	Mangolds, 15 tons Dung, 3 cwt. Guano.	6	Six Acres.
Oats, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Oats, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Fallow.	Wheat, 2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. Guano.	12	Clay-Croft.
Oats, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Fallow.	Wheat (with Clover). 2 cwt. Nitrate Soda.	Clover, Unmanured. Two Crops as Hay.	Barley, 2 cwt. Nitrate Soda (with Grass Seeds).	Grass, Unmanured.	10	Ten Acres.
Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda. Wheat, 3 acres, Experiment.	Barley, 2 1/2 cwt. superphosphate, 3 cwt. Nitrate Soda. Swedes, 3 acres, Experiment.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda. Barley, 3 acres Experiment.	Potatos, Dung and Artificial. (3 acres Experiment 1/2 Beans, 1/2 Fallow.)	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda (3 acres Experiment, Wheat).	Fallow, (3 acres Experiment, Swedes).	9	Agdell.
Oats, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Oats (1/2). 2 1/2 cwt. superphosphate, 3 cwt. Nitrate Soda. Tares (1/2), Dung.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda.	Barley, 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley, 2 1/2 cwt. Guano.	25	Long Hoos.
Barley after Swedes (1/2) 2 cwt. superphosphate, 2 cwt. Nitrate Soda. Wheat after Mangolds (1/2) 1 1/2 cwt. Nitrate Soda.	Barley (with Clover). 2 cwt. superphosphate, 2 cwt. Nitrate Soda.	Barley (1/2). 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda. Tares (1/2). Dung.	Barley. (1) 2 1/2 cwt. superphosphate, 2 1/2 cwt. Nitrate Soda, (2) 2 1/2 cwt. Nit. Soda alone.	Roots (1/2). 25 tons Dung, 1 cwt. Nitrate Soda (Carted off); Fallow (1/2).	Wheat, 50 bushels Soot.	25	Sawyers'.
Oats, 2 cwt. superphosphate, (1) 1 1/2 Nitrate Soda, (2) 2 1/2 Nitrate Soda.	Oats, 2 cwt. superphosphate, (1) 1 1/2 Nitrate Soda, (2) 2 1/2 Nitrate Soda.	Fallow.	Wheat, 2 cwt. Nitrate Soda.	Winter Oats, 2 cwt. Nitrate Soda.	Barley, 50 bushels Soot.	30	West Barn.