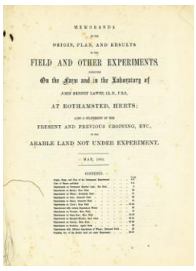
Memoranda of the Field Experiments at Rothamsted: May 1881



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MEMORANDA

OF THE

ORIGIN, PLAN, AND RESULTS

OF THE

FIELD AND OTHER EXPERIMENTS,

CONDUCTED

On the Farm and in the Laboratory of

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

AT ROTHAMSTED, HERTS;

ALSO A STATEMENT OF THE

PRESENT AND PREVIOUS CROPPING, ETC.,

OF THE

ARABLE LAND NOT UNDER EXPERIMENT.

MAY, 1881.

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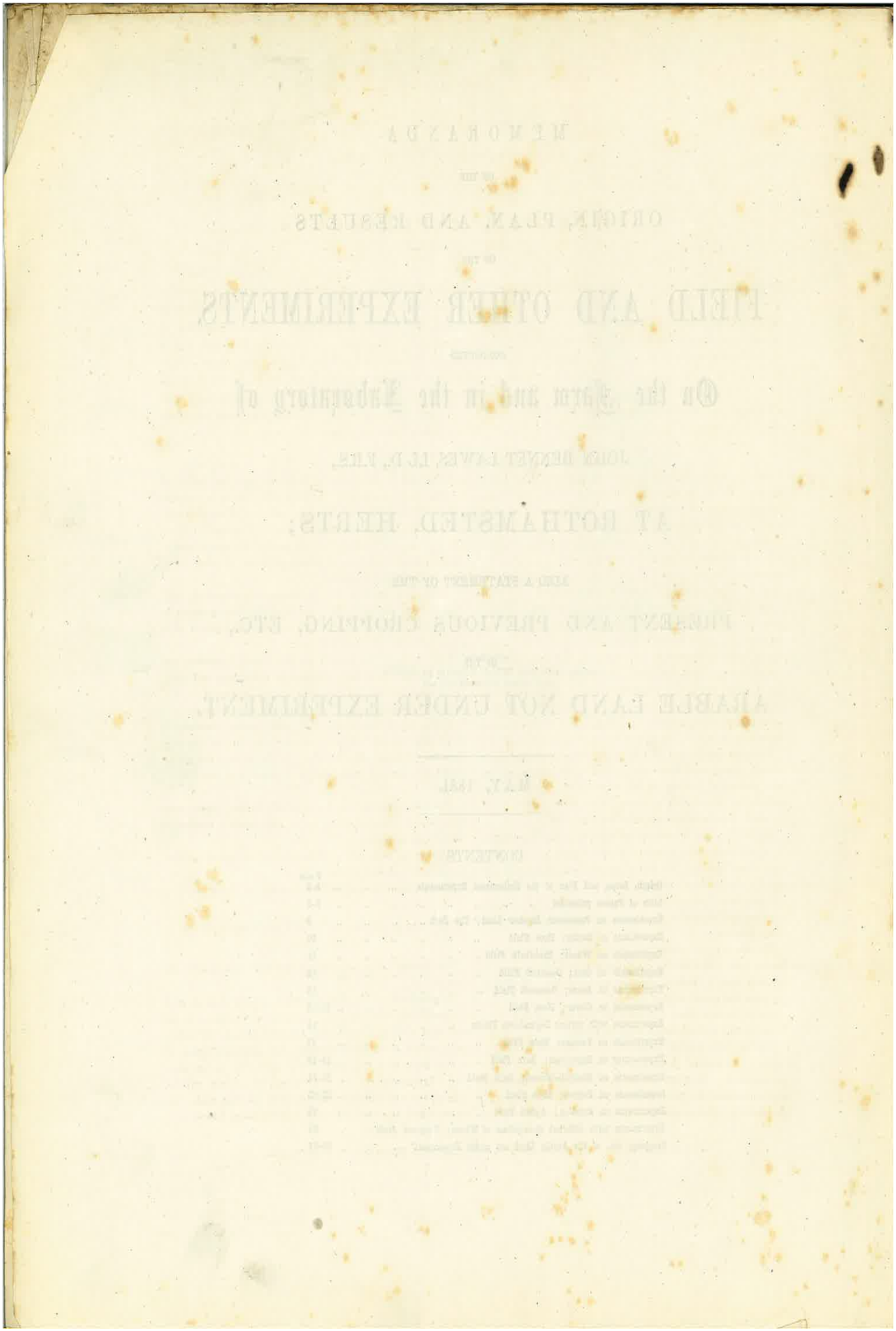

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ORIGIN, SCOPE, AND PLAN,

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 Rothamsted[2] 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 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 about 30,000 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, Etc.

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, without manure, and 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.

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On Wheat, thirty-eight years in succession; 13 acres, 37 plots, many of which are duplicates of others.

On Barley, thirty years in succession; 4½ acres, 29 plots.

On Oats, ten years (including one year fallow); ¾ acre, 6 plots.

On Wheat, alternated with fallow, thirty years; 1 acre, 2 plots.

On different descriptions of Wheat, fourteen 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); 1¼ acre, 10 plots. Also twenty-seven years; 1 acre, 5 plots.

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 is now devoted to experiments with various Leguminous plants, commenced in 1878.

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

On Sugar Beet, five years; about 8 acres, 41 plots.

On Mangold-Wurzel, six years (in progress); about 8 acres, 41 plots.

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

On Rotation, thirty-four years; about 2½ acres, 12 plots.

On permanent Grass-land, twenty-six 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, amides, and nitric acid.

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, Mangold-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 the 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, in the case of samples from selected plots (frequently of both first and second crops), 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 carefully 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-eight years in a gauge of one-thousandth of an acre area, as well as in an ordinary small funnel-gauge of 5 inches diameter. An 8-inch "Board of Trade" copper gauge is also now in use, commencing January 1, 1881. 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 evergreen and deciduous 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.

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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 carcases, 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 fæces 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 fæces, 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) fæces, 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 contituents 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.

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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—1881, 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

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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, February 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
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
41. On Nitrification; Part I., a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., January, 1878) 1878
42. Composition of Potatos (Note—Jour. Roy. Hort. Soc., vol. v., part 5; Proceedings, p. xxxvii.) 1878
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
44. On Nitrification; Part II., a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., July, 1879) 1879
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
46. On the Determination of Nitric Acid by means of Indigo, with special reference to Water Analysis; a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., September, 1879) .. 1879
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
48. On some points in connection with Agricultural Chemistry.—Abstract (Report of the British Association for the Advancement of Science for 1879) .. 1879
49. Our Climate and our Wheat-Crops (Jour. Roy. Ag. Soc. Eng., vol. xvi., s.s., part 1) 1880
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
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
52. Sketch of the Progress of Agricultural Chemistry: Address to the Chemical Section of the British Association (Report of the British Association for the Advancement of Science for 1880) 1880
53. On the determination of Nitric Acid as Nitric Oxide by means of its reaction with Ferrous Salts.—Part I. A Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., July, 1880) .. 1880
54. On the determination of Carbon in Soils; a Report of Experiments made in the Rothamsted Laboratory (Jour. Chem. Soc., September, 1880) 1880
55. On the Home Produce, Imports, Consumption, and Price of Wheat, over twenty-seven (or twenty-eight) harvest-years, 1852–3 to 1879–80 (Jour. Roy. Ag. Soc., vol. xvi., s.s., part 2, 1880) 1880
56. Letter on "Bread Reform" (Journal of the Society of Arts, January 21, 1881) 1881
57. On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted; Parts I. and II. (Jour. Roy. Ag. Soc., Eng., vol. xvii., s.s., part 1, 1881) 1881
58. Letters on "Fertility" (Agricultural Gazette, Feb. 21 and 28; March 7, 14, and 21; April 4, 11, 18, and 25; May 2 and 9, 1881) 1881

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SERIES II.—REPORTS OF EXPERIMENTS ON THE FEEDING OF ANIMALS, SEWAGE UTILISATION, &c. PUBLISHED 1849—1877, INCLUSIVE.

1. Agricultural Chemistry: Sheep Feeding and Manure, Part I. (With Tabular Appendix in 1856.) (Jour. Roy. Ag. Soc. Eng., vol. x., p. 276) 1849
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
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
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
5. Agricultural Chemistry: Pig Feeding (Jour. Roy. Ag. Soc. Eng., vol. xiv., p. 459) 1853
6. On the Equivalency of Starch and Sugar in Food (Report of the British Association for the Advancement of Science for 1854) 1854
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
8. On the Sewage of London (Journal of the Society of Arts, March 7, 1855) 1855
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
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
11. Observations on the recently-introduced Manufactured Foods for Agricultural Stock (Jour. Roy. Ag. Soc. Eng., vol. xix., p. 199) 1858
12. Experimental Inquiry into the Composition of some of the Animals Fed and Slaughtered as Human Food (Philosophical Transactions, Part 2, 1859) .. 1859
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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. A given number was allotted to each Plot, according to the amount of produce, penned upon a portion of it, and the area extended, day by day, until the whole was eaten down. 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. 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. In 1880 the second crops were again made into hay, weighed and removed. It is intended in future to adopt this plan whenever the weather will permit. Owing to this change in the treatment of the crops, the average produce per annum is given, separately, for the first 20 years, 1856–1875, first crops only, and for the succeeding 5 years, 1876–1880, first and second crops ([13]).

(Area under experiment, about 7 acres.)

		Produce per Acre, Weighed as Hay.								
Plots.	Manures, per acre, per Annum.	Average per Annum, 20 Years, 1856–75. (First Crops only.)			Average per Annum, 5 Years, 1876–80. (First and Second Crops.)			Twenty-fifth Season, 1880.			Plots.
		10 Years, 1856–65.	10 Years, 1866–75.	20 Years, 1856–75.	First Crops.	Second Crops ([12]).	Total.	First Crop.	Second Crop.	Total.	
		Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	
1	1856–63, 8 years, 14 tons Farmyard Manure, and 200 lbs. Ammonia-salts ([1]); average produce 49¼ cwts. 1864 and since, 200 lbs. Ammonia-salts alone; average produce (12 years, 1864–75) 38⅜ cwts.	48⅜	37¾	43	32¼	15¼	47½	15	8¼	23¼	1
2	1856–63, 8 years, 14 tons Farmyard Manure; average produce 42⅞ cwts. 1864 and since, unmanured; average produce (12 years, 1864–75) 32⅛ cwts.	41⅝	32	36⅞	23½	12⅞	36⅜	11	7½	18½	2
3	Unmanured, continuously	22½	20	21¼	16⅞	12¼	29⅛	7½	6¾	14¼	3
4 {1	3½ cwts. Superphosphate of Lime ([2])	23¼	21¼	22¼ ([9])	20⅜	14	34⅜	9	9	18	1
4 {2	3½ cwts. Superphosphate of Lime, and 400 lbs. Ammonia-salts	33⅞	30½	32¼ ([9])	33¾	14	47¾	15¼	9½	24¾	2 } 4
5	400 lbs. Ammonia-salts	30½	22	26¼	19½	14¾	34¼	8¼	8¾	17	5
([3]) 6	1856–68, 13 years, 400 lbs. Ammonia-salts; average produce 30⅛ cwts. 1869–78 300 lbs., 1879 and since, 500 lbs., Sul. Pot., 100 lbs. Sul. Soda, 100 lbs. Sul. Mag., 3½ cwts. Superph.; av. prod. (7 yrs., 1869–75) 31¼ cwts.	31⅛	30¼	30¾	34¾	14⅜	49⅛	23½	6½	30	6
7	1856–78 300 lbs., 1879 and since, 500 lbs., Sulphate Potass, 100 lbs. ([4]) Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	33⅞	36¾	35¼	35⅝	18⅛	53¾	22½	6½	29	7
([3]) 8	1856–61, 6 years, 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, and 3½ cwts. Superphosphate; average produce 36 cwts. 1862 and since, 250 lbs. ([5]) Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate; average produce (14 years, 1862–75) 27½ cwts.	33⅜	26¼	30⅛	25¼	12⅝	37⅞	16½	4½	21	8
9	1856–78 300 lbs., 1879 and since, 500 lbs., Sulp. Pot., 100 lbs. ([4]) Sulp. Soda, 100 lbs. Sulp. Mag., 3½ cwts. Superph., and 400 lbs. Ammonia-salts	53⅝	48½	51	53⅞	20	73⅞	40⅞	15	55⅞	9
([3]) 10	1856–61, 6 yrs. 300 lbs. Sulph. Potass, 200 lbs. Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. 55½ cwts. 1862 and since, 250 lbs. ([5]) Sulph. Soda, 100 lbs. Sulph. Magnesia, 3½ cwts. Superphos., 400 lbs. Amm.-salts; av. prod. (14 yrs., 1862–75) 42¼ cwts.	52¾	39⅝	46⅛	40¼	20⅛	60⅜	25¾	14¾	40½	10
11 {1	1856–78 300 lbs., 1879 and since, 500 lbs., Sulph. Potass, 100 lbs. ([4]) Sulp. Soda, 100 lbs. Sulp. Mag., 3½ cwts. Superphos., 800 lbs. ([6]) Ammonia-salts	61¾	53⅝	57⅞	53	38¾	91¾	30	32	62	1
11 {2	1856–78 300 lbs., 1879 and since, 500 lbs., Sul. Pot., 100 lbs. ([4]) Sul. Sod., 100 lbs. Sul. Mag., 3½ cwts. Superph., 800 lbs. ([6]) Am.-salts, and 400 lbs. Sil. Sod. ([7])	63¼	61⅜	62½	62½	32⅜	94⅞	44¾	27⅜	72⅛	2 } 11
12	Unmanured continuously	25	22⅞	24	17⅝	14⅞	32½	9⅜	9⅜	19	12
13	1856–78 300 lbs., 1879 and since, 500 lbs., Sul. Pot., 100 lbs. ([4]) Sul. Sod., 100 lbs. Sul. Mag., 3½ cwts. Superp., 400 lbs. Am.-salts, 2000 lbs. Cut Wheat-straw	55¼	59⅜	57½	59	24⅜	83⅜	51¼	17	68¼	13
14	550 lbs. Nit. of Soda ([8]), 1858–78 300 lbs., 1879 and since, 500 lbs., Sulp. Potass, 100 lbs. ([4]) Sulp. Soda, 100 lbs. Sulp. Mag., and 3½ cwts. Superph.	53⅛	60⅜	57 ([10])	54⅝	15¼	69⅞	51⅜	9	60⅜	14
15	1858–75, 18 years, 550 lbs. Nitrate Soda 1876–78 300 lbs., 1879 and since, 500 lbs., Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	36⅛	35	35⅝ ([10])	28½	14⅝	43⅛	19	9¼	28¼	15
16	275 lbs. Nitrate of Soda, 1858–78 300 lbs., 1879 and since, 500 lbs., Sulp. Potass, 100 lbs. ([4]) Sulp. Soda, 100 lbs. Sulp. Mag., and 3½ cwts. Superph.	45¼	47⅜	46½ ([10])	44⅜	16	60¾	37⅛	11	48⅛	16
17	275 lbs. Nitrate of Soda	34½	33½	33⅞ ([10])	29⅛	13½	42⅜	21½	14	35½	17
18	Mixture supplying the quantity of Potass, Soda, Lime, Magnesia, Phosphoric acid, Silica, and Nitrogen, contained in 1 ton of Hay (commencing 1865)	21	33¼	32⅛ ([11])	34⅝	15⅜	50¼	20	14½	34½	18
19	275 lbs. Nitrate of Soda, 290 lbs. Sulphate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	38⅜ ([12])	39⅝	16¾	55⅞	31½	15½	47	19
20	327 lbs. Nitrate of Potass, and 3½ cwts. Superphosphate (commencing 1872)	..	..	36½ ([12])	40¾	15	55¾	29¼	13	42¼	20

1 acre .. .. = (about) 0·40 Hectare .. .. .. or 1·59 Prussian Morgen.
1 lb. (pound avoir.) .. = (about) 0·45 Kilogramme .. .. .. or 0·91 Zollverein Pfund.
1 cwt. (hundredweight) = (about) 51·0 Kilogrammes .. .. .. or 1·02 Centner.
1 ton .. .. = (about) 1016·0 Kilogrammes .. .. or 20·33 Centner.
1 lb. per acre .. .. = (about) 1·12 Kilogramme per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre .. .. = (about) 125·5 Kilogrammes per Hectare or 0·64 Centner per Pr. Morgen.
1 ton per acre .. .. = (about) 2510·0 Kilogrammes per Hectare or 12·82 Centner per Pr. Morgen.

([1]) "Ammonia-salts"—in all cases equal parts Sulphate and Muriate of Ammonia of Commerce.
([2]) The "Superphosphate of Lime" is, in all cases, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid Sp. gr. 1·7 (and water).
([3]) Plots 6, 8, and 10, had, besides the Manures specified, 2000 lbs. Sawdust per acre per annum for the first 7 years, 1856–1862, but without effect.
([4]) 200 lbs. 1856–63 inclusive. ([5]) 500 lbs. in 1862 and 1863. ([6]) Only 400 lbs. in 1859–60–61.
([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 since, 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 commmenced in 1865.
([12]) Averages of 4 years only, 1872–75.
([13]) As the second crops were not removed in 1876, those of 1875, which were, are brought in to give the 5 years, average of second crops.

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. The crop of the present year, 1881, is, therefore, the 30th Barley crop in succession. 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 4¼ acres.)

1 acre	= (about)	0·40	Hectare	or 1·59	Prussian Morgen.
1 bushel	= (about)	0·36	Hectolitre	or 0·66	Prussian Scheffel.
1 lb. (pound avoir.) ..	= (about)	0·45	Kilogramme	or 0·91	Zollverein Pfund.
1 cwt. (hundredweight)	= (about)	51·0	Kilogrammes	or 1·02	Centner.
1 bushel per acre ..	= (about)	0·9	Hectolitre per Hectare ..	or 0·42	Pr. Scheffel per Pr. Morgen.
1 lb. per acre	= (about)	1·12	Kilogramme per Hectare	or 0·57	Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre ..	= (about)	125·5	Kilogrammes per Hectare	or 0·64	Centner per Pr. Morgen.

Plots.	Manures, per acre, per annum.	Produce per Acre. Average per Annum. Dressed Corn. Quantity. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Weight per Bushel. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Total Straw. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Twenty-ninth Season, 1880. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	Plots.
		Bushels.	Bushels.	Bushels.	lbs.	lbs.	lbs.	Cwts.	Cwts.	Cwts.	Bushels.	lbs.	Cwts.	
1 O.	Unmanured continuously	21⅜	14	17⅞	52	52¼	52⅛	12⅜	8½	10⅜	18¾	51½	9⅞	1 O.
2 O.	3½ cwts. Superphosphate of Lime (1)	27⅜	18¼	23	52⅜	53½	53⅛	14⅜	9¼	11⅞	28⅜	54¼	13½	2 O.
3 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia	24⅜	15⅛	19⅜	52⅜	52⅞	52⅜	13¼	8⅛	10⅜	23¾	51⅞	10⅞	3 O.
4 O.	200 lbs. (2) Sulphate Potass, 100 lbs. (3) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate	30⅛	18⅜	24¼	52⅝	53⅜	53⅛	15½	9⅜	12⅜	30⅛	53⅜	13½	4 O.
1 A.	200 lbs. Ammonia-salts (4)	34¼	26⅛	30¼	51⅜	52⅜	52⅛	19½	14⅜	17⅛	33⅞	51⅞	15⅛	1 A.
2 A.	200 lbs. Ammonia-salts, and 3½ cwts. Superphosphate	48½	41	44⅜	52⅜	53⅞	53½	28½	22⅝	25½	55⅜	53½	26¼	2 A.
3 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	36½	29⅝	33	52¼	53⅛	52¾	21⅜	16⅜	19¼	38⅛	52½	18⅝	3 A.
4 A.	200 lbs. Ammonia-salts, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos.	47⅜	40¾	44¼	53⅛	55	54⅛	29¼	24¾	27	54¾	54¼	29½	4 A.
(5) 1 AA.	275 lbs. Nitrate Soda	39½	28⅛	34	51½	52¼	51⅞	23½	16¾	20	38¼	51⅜	18⅝	1 AA.
(5) 2 AA.	275 lbs. Nitrate Soda, and 3½ cwts. Superphosphate	50⅜	42¾	46½	52¼	54⅜	53⅜	31⅜	25¼	28⅜	57¼	53¾	29⅝	2 AA.
(5) 3 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	39¾	29½	34⅝	51⅜	53¼	52⅛	25⅜	18⅜	21⅞	41¼	50¼	21⅜	3 AA.
(5) 4 AA.	275 lbs. Nitrate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos.	50⅞	42⅜	46⅝	52¼	55	53⅜	34⅛	25⅜	30	59⅜	53⅛	32⅝	4 AA.
(6) 1 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda (6)	39½	34⅛	35	55⅛	53¼	53½	24¼	19⅝	20⅛	44½	52⅝	21½	1 AAS.
(6) 2 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, and 3½ cwts Superphosphate (1)	51⅛	43⅝	44½	54⅜	54⅞	54⅞	28⅜	26¾	27	61½	53⅛	32⅝	2 AAS.
(6) 3 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag.	45½	38½	39¼ (12)	56	54	54¼ (12)	25¾	22⅝	23 (12)	48½	52⅝	23⅜	3 AAS.
(6) 4 AAS.	275 lbs. Nitrate Soda, 400 lbs. Silicate Soda, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag. and 3½ cwts. Superphosphate	54⅞	45¾	46¾	55	55	55	33⅛	29	29⅝	59⅛	53¼	33⅞	4 AAS.
(7) 1 C.	1000 lbs. Rape-cake	46⅞	39	43	52⅜	54⅜	53⅜	28½	22	25⅛	50¼	54½	24	1 C.
(7) 2 C.	1000 lbs. Rape-cake, and 3½ cwts. Superphosphate	48½	40⅜	44½	52⅜	55	53⅞	30	22⅞	26⅜	56	54⅛	28⅞	2 C.
(7) 3 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Magnesia	44⅜	37⅛	41¼	52⅜	54⅜	53⅜	28¼	22	25⅛	51⅜	54⅜	27⅝	3 C.
(7) 4 C.	1000 lbs. Rape-cake, 200 lbs. (2) Sulph. Potass, 100 lbs. (3) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos.	48¼	42¼	45¼	52½	5	53¾	30¾	24¼	27½	55	54½	32⅜	4 C.
(8) 1 N.	275 lbs. Nitrate of Soda	38¾	31⅝	35⅛ (13)	52⅞	52⅜	52⅛ (13)	23⅝	19	21⅛ (13)	39	53⅜	16⅜	1 N.
(8) 2 N.	275 lbs. (9) Nitrate of Soda	43	35¼	39 (13)	51⅞	53⅝	52¾ (13)	27¼	21	24⅛ (13)	46	53⅜	21⅜	2 N.
5 O.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate (10)	24⅛	15⅞	19⅞ (13)	52⅜	53¼	53⅛ (13)	13⅜	8⅜	10⅜ (13)	21⅞	52⅜	7⅞	5 O.
5 A.	200 lbs. (2) Sulphate of Potass, 3½ cwts. Superphosphate, and 200 lbs. (11) Ammonia-salts	45⅜	38¾	42 (13)	52⅞	54⅞	53⅞ (13)	29	23⅞	26⅛ (13)	54¾	51⅜	36⅛	5 A.
M.	100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, and 3½ cwts. Superphosphate	22¼	17¼	19¼ (14)	53⅛	53½	53⅜ (14)	12⅞	10	11⅜ (14)	30⅜	53¾	14¾	M.
6 (1)	Unmanured continuously	24⅓	14¼	19½	52⅛	52⅜	52¼	13⅜	8⅜	10⅞	21½	50⅞	10¼	1 6
6 (2)	Ashes (burnt soil and turf)	23⅜	15¼	19¾	52¼	52¾	52½	12¾	8½	10⅜	25⅜	52¼	9⅜	2 6
7 (1)	Farmyard Manure 14 tons, 20 yrs., 1852–71, av. prod. 48¾ bush.; unmanured since, av. prod., 9 yrs., 1872–80, 34⅜ bush.	48¼	33¾	44⅛ (15)	54⅜	53¾	54¼ (15)	28¼	19⅛	25⅝ (16)	41¾	54½	19	1 7
7 (2)	Farmyard Manure 14 tons, every year; av. produce, 20 years, 1852–71, 48¼ bush.; 9 years, 1872–80, 49¾ bush.	48¼	48⅛	48¼	53⅜	55	54¼	28⅜	20⅜	28⅝	65¼	52¾	35⅜	2 7

(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 Muriate of Ammonia of Commerce.

(5) First 6 years, 1852–7, instead of Nitrate of Soda, 400 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 Silicates did not commence until 1864; in 1864-5-6 and 7, 200 lbs. Silicate of Soda and 200 lbs. Silicate of Lime were applied per acre, but in 1868, and since, 400 lbs. Silicate of Soda, and no Silicate of Lime. These plots ("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) 2000 lbs. Rape-cake per annum for the first six years, and 1000 lbs. only, each year since.

(8) 300 lbs. Sulphate of Potass, and 3½ cwts. 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) By mistake 400 lbs. in 1880.

(12) Averages of 2 years, 14 years, and 16 years.

(13) Averages of 13 years, 14 years, and 27 years.

(14) Averages of 8 years, 13 years, and 21 years, (not 8, 14, and 22 years, as the produce of 1879 was not weighed, owing to the foulness of the plot, from the wet season).

(15) Averages of 20 years (with dung), 8 years (unmanured), and 28 years.

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 30 years (1852 and since). The Crop of the present year, 1881, is, therefore, the 38th Wheat Crop in succession. 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 1878.

(Area under experiment, about 13 acres.)

1 acre .. .. .. = (about)	0·40 Hectare .. .. or 1·59 Prussian Morgen.
1 bushel .. .. = (about)	0·36 Hectolitre .. .. .. or 0·66 Prussian Scheffel.
1 lb. (pound avoir.) = (about)	0·45 Kilogramme .. .. .. or 0·91 Zollverein Pfund.
1 cwt. (hundredweight) = (about)	51·0 Kilogrammes .. .. .. or 1·02 Centner.
1 bushel per acre .. = (about)	0·9 Hectolitre per Hectare .. or 0·42 Pr. Scheffel per Pr. Morgen.
1 lb. per acre .. = (about)	1·12 Kilogramme per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre .. = (about)	125·5 Kilogrammes per Hectare or 0·64 Centner per Pr. Morgen.

Plots.	Manures, per acre, per annum.	Produce per Acre. Average per Annum. Dressed Corn. Quantity. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Weight per Bushel. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Total Straw. 14 Years, 1852–65.	14 Years, 1866–79.	28 Years, 1852–79.	Thirty-Seventh Season, 1880. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	Plots.
		Bushels.	Bushels.	Bushels.	lbs.	lbs.	lbs.	Cwts.	Cwts.	Cwts.	Bushels.	lbs.	Cwts.	
0	Superphosphate of Lime (three times as much as on No. 5 and succeeding Plots)	18	14⅝	16⅜	58	58⅛	58¼	15¾	11⅞	13⅞	16¼	58⅜	11⅜	0
1	Sulphates of Potass, Soda, and Magnesia (twice as much as on No. 5 and succeeding Plots)	16	10½	13¼	57⅜	58⅜	58	15	9⅛	12	11	57⅜	10¼	1
2	Farmyard Manure (14 tons every year)	35¾	31¼	33½	59¾	60¼	60	34⅛	30⅜	32¼	38⅜	60½	34⅞	2
3	Unmanured continuously	15⅜	11	13¼	57¼	58¼	57⅜	14¼	9⅜	11⅝	11⅛	56⅞	10¼	3
4	Unmanured for Crop of 1852, and since; previously Superphosphate (made with Muriatic Acid), and Sulphate Ammonia ..	16¾	11½	14⅛	57⅜	58⅜	58⅛	14⅞	9½	12¼	12⅜	57⅜	11¼	4
5 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, 3½ cwts. Superphosphate of Lime (3) ..	18	12⅝	15¼	58⅜	58⅜	58⅜	16⅛	10½	13⅜	17⅜	59¼	15½	5 (*a* and *b*)
6 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Mag., 3½ cwts. Superphos., 200 lbs. Ammonia-salts (4)	28¼	19¾	24	59	59⅛	59⅜	26¼	18⅜	22⅜	26⅞	59¾	26	6 (*a* and *b*)
7 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Mag., 3½ cwts. Superphos., 400 lbs. Ammonia-salts ..	37¼	28	32⅝	58⅞	59⅜	59⅜	37⅜	29¼	33½	34½	59⅜	35⅜	7 (*a* and *b*)
8 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Mag., 3½ cwts. Superphos., 600 lbs. Ammonia-salts ..	39¼	33⅛	36¼	58⅜	59¾	59⅛	42⅜	38	40¼	35¼	59⅛	40	8 (*a* and *b*)
9 (*a*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Mag., 3½ cwts. Superphos., 550 lbs. Nitrate Soda (5)	36⅜	36⅛	36¼	57⅜	59⅜	58½	40⅜	42⅝	41⅝	34⅛	57⅜	39¼	9 (*a* and *b*)
9 (*b*)	550 lbs. Nitrate of Soda (5). (The Nitrate for both 9*a* and 9*b* always sown in the Spring.)	26⅜	21½	24	56⅛	56½	56⅜	28½	23¼	25⅞	10½	53½	12⅜	
10 (*a*)	400 lbs. Ammonia-salts alone, for 1845, and each year since; Mineral Manure in 1844	23½	18⅜	21	56½	57	56⅜	23¼	16⅜	19⅜	10⅝	54⅞	11⅛	
10 (*b*)	400 lbs. Ammonia-salts alone, for 1845, and each year since (except 1846 and 1850); Mineral Manure 1844, '48, '50 ..	27⅞	19⅜	23⅜	57½	57½	57½	27¼	17¾	22¼	13½	53½	14⅜	
11 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate	30	22¼	26⅛	56⅜	58⅛	57⅜	28¾	21⅜	25	25⅜	57⅞	25½	11 (*a* and *b*)
12 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 366½ lbs. (6) Sulphate of Soda	35⅜	26⅜	31¼	58⅜	59½	59⅛	35	25⅞	30⅜	29⅜	59	29⅛	12 (*a* and *b*)
13 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 200 lbs. (6) Sulphate of Potass	35⅜	27¾	31⅝	59⅛	60⅜	59⅜	35⅝	28⅝	32⅛	33	59⅜	33½	13 (*a* and *b*)
14 (*a* and *b*)	400 lbs. Ammonia-salts, 3½ cwts. Superphosphate, and 280 lbs. (6) Sulphate of Magnesia	35½	27⅜	31⅝	58¾	59⅜	59½	35¼	27	31⅛	31	58⅜	29⅜	14 (*a* and *b*)
15 (*a*)	200 lbs. (1) Sulph. Pot., 100 lbs. (2) Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. (7); 400 lbs. Amm.-salts, in Autm. (8)	33⅜	27½	30⅛	59	60	59½	33⅝	26⅞	30⅛	36⅞	60⅜	37¾	15 (*a* and *b*)
15 (*b*)	200 lbs. (1) Sulph. Pot., 100 lbs. (2) Sulph. Sod., 100 lbs. Sulph. Mag., 3½ cwts. Superphos. (7); 400 lbs. Amm.-salts, in Autm. (9)	35⅛	28½	31¾	59¼	60	59⅜	35½	27⅜	31¾	35½	60¾	34⅛	
16 (*a* and *b*)	1852–64, 13 years, 200 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos., and 800 lbs. Ammonia-salts; average produce 39½ bush. Corn, 46⅜ cwts. Straw .. .. 1865 and since, unmanured; average produce (16 years, 1865–80) 14¾ bushels Corn, 13 cwts. Straw	39	13⅜	26¼	58⅜	59⅛	58⅜	45½	12⅛	28⅝	14⅜	58¼	13⅜	16 (*a* and *b*)
(10) 17 (*a* and *b*)	200 lbs. (1) Sulphate Potass, 100 lbs. (2) Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	18⅜	13	15⅜ (12)	58½	58¾	58½ (12)	17¼	11⅝	14⅜ (12)	32⅜	60½	29⅜ (14)	17 (*a* and *b*)
(10) 18 (*a* and *b*)	400 lbs. Ammonia-salts	32⅜	26¼	29¼ (13)	59	60	59½ (13)	33	26½	29¾ (13)	15	57⅞	12 (15)	18 (*a* and *b*)
19	1878-9, and since, 1700 lbs. Rape-cake; 1852-78, 3½ cwts. Superp. Lime (11), 300 lbs. Sulp. Am., and 500 lbs. Rape-cake, in Autm.	32⅛	24⅞	28⅛	58½	58⅝	58⅜	31	22¼	26⅜	32½	58⅜	29	19
20	Unmanured continuously	15¼	10⅞	13¼ (16)	57⅜	57½	57⅝ (16)	14⅜	10	12½ (16)	12⅜	56⅝	9⅜	20
21	200 lbs. (1) Sulph. Potass, 100 lbs. (2) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos., 100 lbs. Muriate Ammonia	22	17	19⅛	58½	58⅞	58⅜	20⅜	14⅜	17½	16½	57¼	14½	21
22	200 lbs. (1) Sulph. Potass, 100 lbs. (2) Sulph. Soda, 100 lbs. Sulph. Mag., 3½ cwts. Superphos., 100 lbs. Sulphate Ammonia	21⅜	18	19⅞	58¼	58¾	58½	20	15⅝	17⅞	26½	57¼	22	22

(1) 300 lbs. per annum for Crop of 1858, and previously.
(2) 200 lbs. per annum for Crop of 1858, and previously.
(3) "Superphosphate of Lime"—in all cases, excepting for Plot 19, made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid sp. gr. 1·7 (and water).
(4) The "Ammonia-salts," in all cases, equal parts Sulphate and Muriate of Ammonia of Commerce.
(5) 9*a*, 475 lbs. Nitrate Soda in 1852, 275 lbs. in 1853 and 1854, 550 lbs. each year since. No Sulphate of Potass, Soda, or Magnesia, or Superphosphate, in 1852, 1853, or 1854. 9*b*, 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."
(6) For 1858, and previously—1½ time as much.
(7) For 1872 and previously, made with Muriatic instead of Sulphuric Acid.
(8) For 1872 and previously, 400 lbs. Sulphate Ammonia, sown in the Autumn; 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.
(9) 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.
(10) The Manures of Plots 17 and 18 are, year by year, transposed.
(11) Made with Muriatic instead of Sulphuric Acid.
(12) Averages of Mineral Manures, alternated with Ammonia-salts.
(13) Averages of Ammonia-salts, alternated with Mineral Manures.
(14) Plots 17 had the Ammonia-salts for the Crop of 1880.
(15) Plots 18 had the Mineral Manures for the Crop of 1880.
(16) Averages of 14 years, 13 years, and 27 years only; as, in 1868, owing to a mistake in carting, the produce could not be ascertained.

The Plots marked "(*a* and *b*)" are divided into duplicate portions, "*a*" and "*b*," respectively, which are manured alike; excepting that, for the crops of 1864-5-6 and 7, the "*a*" portions of plots 5, 6, 7, 8, 9, 16, and 17 (or 18), received a mixture of soluble Silicates in addition to the other Manures, but, hitherto, without any material effect; and for the crops of 1868 to 1879 inclusive, cut straw (that produced in the previous season) was applied (instead of Silicates) on the "*a*" portions of plots 5, 6, 7, 8, 11, 12, 13, 14, and 17 (or 18); also for the crop of 1874, and each succeeding crop to 1879 inclusive, the straw of the previous season was cut up and applied to the "*a*" portion of Plot 15. For the crop of 1880, and since, the return of the straw has been discontinued.

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, ¾ acre.)

PLOTS.	MANURES, PER ACRE, PER ANNUM.	PRODUCE PER ACRE. 1ST SEASON, 1869. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	2ND SEASON, 1870. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	3RD SEASON, 1871. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	4TH SEASON, 1872. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	5TH SEASON, 1873. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.	AVERAGE PER ANNUM 5 YEARS, 1869–1873. Dressed Corn. Quantity.	Weight per Bushel.	Total Straw.
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.
1	Unmanured	36⅜	36¾	19¼	16⅜	35	9⅛	20½	33¼	11¼	15	36¼	7⅛	10¾	27⅛	5⅜	19⅞	33¾	10⅜
2	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate of Lime (1)	45	38½	24½	19⅛	35⅛	9⅝	22	35¼	13½	19½	37¾	10⅜	17	28⅝	8⅝	24½	35	13⅜
3	400 lbs. Ammonia-salts (2)	56⅛	37½	36⅞	30	34⅞	17¼	57⅛	36⅜	40⅝	55¾	37½	30⅝	36½	32⅝	16¾	47	35⅞	28½
4	400 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	75¼	39¼	54	50⅝	36	28⅝	58⅝	35⅜	50	62⅜	39½	45⅛	48¼	34¾	27⅝	59	37	41⅛
5	550 lbs. Nitrate of Soda (3)	62¼	38½	42¾	36½	35¼	23	55	36⅜	34¾	42⅛	36⅜	20⅝	39¾	30¼	16½	47⅛	35½	27½
6	550 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	69⅜	38½	49⅞	50	35¾	28¾	60¼	33¾	48⅜	44⅝	37¼	24	63⅜	33⅝	24	57½	35¾	35

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 (5).			9TH SEASON, 1877 (6). FALLOW.			10TH SEASON, 1878.			AVERAGE PER ANNUM 4 YEARS, 1874, 5, 6, AND 8.		
		Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.	Bushels.	lbs.	cwts.
1	Unmanured	12	31½	7	12½	29⅜	5⅞	8⅛	32	2⅜	..	..	..	22¼	32	8⅜	13¾	31¼	6
2	200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate of Lime (1)	13⅜	31¼	6½	13⅛	29¾	6⅞	7¾	30	2⅜	..	..	..	17¾	35¼	8¼	13⅛	31⅝	6⅛
3	200 lbs. Ammonia-salts (2)	37¼	33¼	22⅞	30⅜	32⅞	15⅜	17⅝	34⅛	6	..	..	..	30	32¾	12⅜	28⅞	33½	14⅛
4	200 lbs. Ammonia-salts, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	46¾	34⅝	24⅝	30⅝	34⅞	20¼	29¼	35½	12½	..	..	..	45⅜	37	22½	38	35½	20
5	275 lbs. Nitrate of Soda (3)	35⅛ (4)	30 (4)	16½ (4)	23½ (4)	31¼ (4)	11⅜ (4)	12¾	30⅞	3⅞	..	..	..	34⅛	34¼	12½	26⅜	31⅝	11⅛
6	275 lbs. Nitrate of Soda, 200 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia, and 3½ cwts. Superphosphate	28½ (4)	33½ (4)	16⅜ (4)	28⅜ (4)	33⅜ (4)	14½ (4)	19⅜	33¼	8	..	..	..	37	36¼	17⅛	28½	34⅛	14⅛

(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) 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 without a break, 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 it was 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.

Early in October, 1876, winter Beans were put in (drilled), without further manuring.

In 1878 the usual manures were sown, and beans were drilled on February 26.

Owing to the wetness of the winter, and the foul condition of the land, it was left fallow in 1879.

Owing to the continued wetness in the autumn, the severe winter, and foulness of the land, it could not be got into order for sowing, and remained fallow in 1880.

During 1880 the land was ploughed, scarified, and partially cleaned, but owing to the wetness of the autumn and the wetness and severity of the winter, it was again impossible to work the land in time for sowing; and it still remains fallow (1881).

The general result of the experiments with Beans has been that mineral constituents used as manure (more particularly potass), increased the produce very much during the early years; and, to a certain extent, afterwards, whenever the season was favourable for the crop. Ammonia-salts, on the other hand, produced very little effect; notwithstanding that a Leguminous crop contains two, three, or more times as much nitrogen as a Gramineous one grown under similar conditions as to soil, &c. Nitrate of soda has, however, produced more 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 1881).

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

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

II.—Red Clover (*Trifolium pratense*).

1. *Experiments on ordinary arable land.*—Hoos Field.

Experiments on the growth of Clover, on ordinary arable land, with many different descriptions of manure, were commenced in 1849, and, with the occasional interposition of a corn-crop, or fallow, were continued up to 1877, inclusive.

As with other *Leguminous* crops, the result was, that mineral constituents applied as manure (particularly potass) considerably increased the early crops. Ammonia-salts had little or no beneficial effect, and were sometimes injurious. It may be added, that the beneficial effects of long previous applications of potass have been apparent whenever there was 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 this ordinary arable land have failed to give anything like a full crop, or even 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.

In April 1868 a portion only of the land was sown with Clover, and the plant for the most part died off in the winter.

In April 1869 the same portion was resown, and gave a small cutting 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.

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

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 (1875); 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.

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 12 times during the 30 years, 1848–1877, and more frequently alone than with a corn-crop; but in 9 out of the last 10 trials the plant died off in the winter and spring succeeding the sowing the seed.

In 1878 the land was devoted to experiments with various Leguminous plants, differently manured, and these experiments are still in progress (1881); for further particulars see p. 16.

In reference to these field experiments on clover, 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 a number of small beds, each 3 yards × 2, were arranged on the previously unmanured plot of the experimental land. These 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 three similar sized beds, the soil was removed to the depths of 9, 18, and 27 inches respectively, and replaced by soil taken at the same depths from a garden border, on a portion of which Clover had been grown successfully since 1854, as described on the next page.

In April 1868 clover was sown on the whole of these small beds (as well as on some other portions of the experimental land); but the plant for the most part died off during the following winter.

In April 1869 the small beds (and the other portions as in 1868) 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 again sown on the small beds in conjunction with barley (as on all the rest of the experimental land), but the plant again died in the winter.

In the spring of 1871 the small beds were again re-sown, and the three 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 beds of garden-soil, 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 to the greatest depths.

In April 1874 there was still some healthy plant on all the beds, but it was considered to be too irregular to preserve. It was, therefore, dug in. The artificially-manured beds 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 three beds of garden-soil, 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.

More small beds 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. At this time, the wire netting was removed from above the three beds of garden-soil, but the whole series of small beds was now surrounded with netting, to keep out ground game. One series of the new plots 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) from these new beds; the blanks in the rows were re-sown on July 24; a second cutting was taken on August 17; and the blanks were again re-sown on September 22 (1875). The plant was the most even on the beds 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.

In May, 1875, the plant was entirely gone on the old artificially-manured beds, which were then dug up, and prepared for re-sowing. On the three beds of garden-soil, though the rows were imperfect, some healthy plants still remained, and gave a small cutting on June 22. On July 24 these beds 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 beds of garden-soil were entirely gone, and those on the artificially manured ones nearly so, but they yielded small cuttings on July 17 (1876).

The plants on the new artificially manured beds, 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 (1876); 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. All came up well, but the plants were for the most part destroyed by the severe winter which followed.

In May, 1881, there was perhaps half a plant on two or three only out of the forty small beds; namely, where the mixed mineral manure, including potass, was used without nitrogenous manure; and the greatest vigour was where the manure was applied in the largest quantity, and to the greatest depths. On no other beds (not even on the three made up of garden-soil) was there nearly as much plant; and now (May 1881) all the small beds have been cleaned, the clover plants forked in, manures also forked in, as in 1876, to a depth of 8 or 9 inches, and clover seed sown.

It will be observed that, although in the earlier years, the three small beds in the field which had been artificially made up of surface-soil and subsoil brought from a highly manured

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Experiments with various **LEGUMINOUS PLANTS.**—HOOS FIELD.

The land upon which attempts had been made to grow Red Clover in frequent succession since 1849, was devoted to experiments with various Leguminous Plants in 1878; so that the present season, 1881, is the fourth year of these experiments.

The object was to ascertain whether, among a selection of plants all belonging to the Leguminous family, but of different habits of growth, and especially of different character and range of roots, some could be grown successfully for a longer time, and would yield more produce, containing more nitrogen as well as other constituents, than others; all being supplied with the same descriptions and quantities of manuring substances, applied to the surface soil. Further, whether the success in some cases, and the failure in others, would afford additional evidence as to the source of the nitrogen of the Leguminosæ generally, and as to the causes of the failure of Red Clover in particular, when it is grown too frequently on the same land.

Below, is given a list of the plants now growing (1881), all of which were sown on April 9; and, excepting in the few cases stated, the same description has been sown in each of the four years.

Below, is also given a Table showing the description and quantities of the manures applied to the different plots. It will be seen that there are three "*Series*," each of which comprises 6 plots. The same mineral manure (if any) is applied to the same plot of each *Series*. *Series* 1, has mineral manure only; *Series* 2, the same mineral manure, and nitrates of soda; *Series* 3, the same mineral manure, and on one portion ammonia-salts, on another a dressing of cow's urine, and on another rape-cake, in addition. The mineral manures were applied in the quantities per acre stated in the Table, in 1878, and in 1880. The nitrate of soda, and the ammonia-salts, have been applied, in the quantities stated, in each of the four years, 1878, 1879, 1880, and 1881. The cows'-urine was applied in the second year only, 1879. The rape-cake was applied in the first and third years, 1878 and 1880; in the former on three lands, but in the latter on only two.

It is estimated that already several times as much nitrogen has been removed in some of the other plants as in the Red Clover; but it is too soon to form any general conclusions from the results.

(Area under Experiment, about 3 acres, each plot, about $\frac{1}{6}$th acre.)

Nos.	Plants Grown on each Plot.		
	Botanical Names.	Common Names.	Notes.
1	Trifolium pratense	Common Red, or Broad Clover.	
2	Trifolium pratense perenne	Perennial Clover. or Cow-grass.	
3	Trifolium pratense hybridum	Suttons hybrid (Cow Clover).	
4	Trifolium repens	Common white, or Dutch Clover.	
5	Trifolium repens perenne	Giant perennial, White Clover.	
6	Trifolium hybridum	Alsike Clover.	
7	Trifolium incarnatum	Early Red or Crimson Clover.	
8	Trifolium tardiflora album	Late White Clover	T. procumbens (yellow Trefoil, or-Hop Clover) in 1878 and 1879. T. incarnatum (late Red Clover) in 1880.
9	Medicago lupulina	Non-such, or Black Medick.	
10	Medicago sativa	Lucerne, or Purple Medick	No seed sown in 1878.
11	Melilotus leucantha	Bokhara Clover.	
12	Lotus corniculatus	Common Bird's-foot Trefoil	
13	Vicia sativa	Summer Tare, or Vetch.	
14	Onobrychis sativa	Common Sainfoin	Lathyrus pratensis (Meadow Vetchling) in 1878.

Plots.	Manures; Quantities per Acre.			
	Series 1 (5 Lands).[1] Without Mineral Manure, or with Mineral Manure only.	Series 2. (5 Lands);[1] Each Plot as Series 1, and—	Series 3 (5 Lands). (1 Land); Each Plot as Series 1, and—	Series 3 (5 Lands). (2 Lands); Each Plot as Series 1, and—	Series 3 (5 Lands). 2 Lands); Each Plot as Series 1, and—
1	**Without Mineral Manure.** (Series 1 portion devoted to the experiments on "Small Beds," 1867–8, and since)	Nitrate Soda, 550 lbs. in 1878; 275 lbs. in 1879, 1880, and 1881.	Ammonia-salts, 400 lbs. in 1878; 200 lbs. in 1879, 1880, and 1881.	Cows' Urine, 6120 lbs. in 1879 only. [2]	Rape Cake, 2000 lbs. in 1878 and 1880.
2	5 cwts. Superphosphate of Lime [3]				
3	1000 lbs. Sulphate Potass				
4	1000 lbs. Sulphate Potass, 5 cwts. Superphosphate				
5	1000 lbs. Sulphate Potass, 250 lbs. Chloride Sodium, 250 lbs. Sulphate Lime, 250 lbs. Sulphate Magnesia				
6	1000 lbs. Sulphate Potass, 250 lbs. Chloride Sodium, 250 lbs. Sulphate Lime, 250 lbs. Sulphate Magnesia, 5 cwts. Superphosphate				

(1) In November 1879, Lime was applied to one land of Series 1, and to the adjoining land of Series 2, in addition to the other manures.
(2) One of the two lands had received rape-cake in 1878.
(3) "Superphosphate of Lime"—in all cases, made from 300 lbs. Bone-ash, 225 lbs. Sulphuric acid sp. gr. 1·7 (and water).

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. 18 and 19.
In 1876 experiments with Mangold-wurzel were substituted, and are still in progress (see pages 20 and 21).

(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.

Plots.	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. 1840 lbs. Rape-cake.	
		Average Produce, per Acre, per Annum.							
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		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	6 11	3 3
4	Superphosphate, each year; Potass, Soda, and Magnesia, 1847–8 ..	8 1	2 15	9 15	4 3	10 5	6 1	11 2	4 12
5	Superphosphate, each year;	8 16	2 19	9 18	4 8	10 1	6 3	10 18	4 15
6, 7	Superphosphate, each year; and Potass 1847–8	8 0	2 19	9 16	5 4	10 7	6 17	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).

Plots.	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.	
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		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	0 17	7 14	0 13
4	Superphosphate, Sulphates Potass and Magnesia, and Soda-ash ..	7 17	0 10	9 9	0 11	13 1	0 18	12 7	0 15
5	Superphosphate	7 9	0 11	8 14	0 13	11 4	1 1	10 10	0 17
6, 7	Superphosphate, and Sulphate Potass	6 16	0 9	8 14	0 10	12 8	0 17	11 14	0 14

Barley, without Manure (after Roots manured as above); Three Seasons, 1853–1855.

Plots.	Series 1.	Series 2.	Series 3.		Series 4.		Series 5.	
			Dressed Corn.	Straw.	Dressed Corn.	Straw.	Dressed Corn.	Straw.
			Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.
3	.. ..		18¾	12½	20½	12⅔	24½	15⅔	25⅞	16
4	.. ..		20¾	12¼	22½	13	25	14¾	25¼	14⅞
5	.. ..		21	11⅞	23	12¾	26¾	15	27	15½
6, 7	.. ..		18¾	10⅞	20½	11⅞	25	14⅜	25	14⅞

Swedish Turnips; Fifteen Seasons, 1856–1870.(1) Roots and Leaves carted off the Land.

Plots.	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. 10 years, 1861–1870. 550 lbs. Nitrate Soda.		Series 3. 5 years, 1856–1860. 200 lbs. Ammonia-salts. 10 years, 1861–1870. 400 lbs. Ammonia-salts.		Series 4. 5 years, 1856–1860. 200 lbs. Ammonia-salts. 3000 lbs. Sawdust. 10 years. 1861–1870. 400 lbs. Ammonia-salts. 2000 lbs. Rape-cake.		Series 5. 5 years, 1856–1860. 3000 lbs. Sawdust. 10 years, 1861–1870. 2000 lbs. Rape-cake.	
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		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	8 16	1 9	8 0	1 4
2	Farmyard Manure, 14 tons, and Superphosphate	6 7	0 16	7 13	1 3	8 5	1 5	8 14	1 9	7 16	1 2
3	Without Manure, 1846, and since	0 11	0 3	0 19	0 4	0 13	0 3	3 6	0 14	3 8	0 13
4	Superphosph., each year; Sulph. Potass, Soda, and Magnesia, 1856–60	2 16	0 8	5 2	0 16	4 12	0 14	6 12	1 6	5 8	0 17
5	Superphosphate, each year	2 12	0 9	4 13	0 18	3 16	0 15	5 16	1 7	5 0	0 19
6	Superphosphate, each year; Sulphate Potass, 1856–1860	2 7	0 7	4 11	0 14	4 5	0 13	6 6	1 2	5 3	0 16
7	Superphosph., each year; Sulph. Potass, and 36½ Amm.-salts, 1856–60	2 12	0 7	4 13	0 14	4 12	0 14	6 15	1 4	5 9	0 17
8	Unman. 1853, and since; previously part Unman.; part Superphosph.	1 3	0 4	1 13	0 5	1 2	0 5	3 19	0 18	3 14	0 19

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 = 50 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 13 years is, in each case, divided by 15.

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Experiments on SUGAR BEET (Vilmorin's Green-top White Silesian)—BARN FIELD.

Grown year after year on the same Land, without Manure, and with different descriptions of Manure, commencing 1871.

Previous Cropping:—1843–'48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure.
1849–'52 (4 Seasons), experiments on Swede Turnips, with different descriptions of Manure.
1853–'55 (3 Seasons), Barley without Manure (with a view as far as possible to equalise the condition of the Plots).
1856–'70 (15 Seasons), experiments on Swede Turnips, with different descriptions of Manure, in which the arrangement of the Plots was the same, and that of the Manures very similar—in fact, exactly the same during the last 10 years—as in the first year of Sugar Beet, excepting that, during those 10 years, the Alkalies were omitted for the Swedes. For the second and subsequent years of Sugar Beet slight alterations in the Mineral Manures were made, and in the fourth and fifth years the Farmyard Manure, Nitrate of Soda, Ammonia-salts, and Rape-cake were omitted, as will be seen below. Seed dibbled on the flat; in rows 22 inches apart, and 11 inches apart in the rows; plants moulded up afterwards Roots all carted off, Leaves weighed, spread on the respective Plots, and ploughed in.

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

Plots.	Manures, per Acre, per Annum. Series 1.	Series 2. Each Plot as Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.		Series 3. Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."		Series 4. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."		Series 5. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake.	
	First Season, 1871. Produce per Acre (Roots trimmed as for feeding, not as for Sugar-making).	Roots.	Leaves.	Roots.	Leaves.	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.
1	Farmyard Manure (14 tons)	18 3	3 5	27 13	6 19	22 1	5 6	26 4	6 14	28 18	5 14
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	14 13	2 14	25 16	5 15	21 15	4 6	25 2	6 7	25 4	5 5
3	Without Manure (1846, and since)	7 11	2 0	22 3	5 12	15 6	4 16	19 18	7 0	20 16	4 12
4	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 200 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia	7 11	1 5	22 15	4 8	17 10	3 5	22 15	6 3	21 7	3 19
5	3½ cwts. Superphosphate	5 12	1 8	20 19	3 14	15 4	3 19	19 18	7 12	18 19	4 5
6	3½ cwts. Superphos., 300 lbs. Sulph. Potass	5 1	1 4	21 5	3 13	17 4	3 4	23 11	6 11	21 0	3 11
7	3½ cwts. Superphos., 300 lbs. Sulph. Pot., 36½ lbs. Amm.-salts (2)	5 18	1 5	20 19	3 18	18 8	4 3	21 0	5 0	21 7	3 17
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	7 10	1 14	21 13	3 16	16 2	4 15	17 19	7 11	20 7	4 9
	Second Season, 1872.	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)	15 13	4 2	23 9	7 19	22 14	9 0	26 8	9 11	22 5	6 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	16 0	3 18	24 6	8 16	22 0	7 16	25 9	9 14	20 15	5 11
3	Without Manure (1846, and since)	7 17	1 13	21 7	6 6	15 3	4 13	20 8	10 1	16 3	3 11
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	6 14	1 10	20 2	5 19	15 10	3 7	23 8	7 13	17 18	3 15
5	3½ cwts. Superphosphate	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4	15 18	3 16
6	3½ cwts. Superphos., 500 lbs. Sulph. Potass	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9	15 17	3 14
7	3½ cwts. Superphos., 500 lbs. Sulph. Potass, 36½ lbs. Amm.-salts (2)	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10	15 10	3 15
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 4	1 5	15 6	5 19	13 10	4 1	19 12	9 17	15 0	4 6
	Third Season, 1873.	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)	15 2	5 12	20 5	10 9	22 2	9 18	22 15	12 10	23 10	7 8
2	Farmyard Manure (14 tons) and 3½ cwts. Superphosphate (1)	14 6	5 2	21 10	11 0	19 4	8 9	23 7	13 6	21 18	6 18
3	Without Manure (1846, and since)	5 1	1 11	14 5	6 11	9 3	3 16	15 12	9 11	14 13	4 1
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 2	1 13	16 9	6 11	12 10	3 10	20 3	8 0	16 1	3 8
5	3½ cwts. Superphosphate	5 5	1 11	18 8	5 13	10 19	5 0	14 15	9 8	13 19	4 9
6	3½ cwts. Superphos., 500 lbs. Sulph. Potass	4 12	1 5	15 17	4 4	12 18	3 12	20 2	9 5	14 14	3 11
7	3½ cwts. Superphos., 500 lbs. Sulph. Potass, 36½ lbs. Amm.-salts (2)	5 19	1 12	16 14	5 3	13 0	4 15	19 16	9 0	15 17	4 4
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 11	1 7	12 9	5 18	8 8	2 19	15 2	9 8	12 2	3 16
	Fourth Season, 1874 (3). Mineral Manures as in 1872 and 1873; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Without Manure, 1874 and 1875 (Farmyard Manure in '71, '72, '73)	10 16	5 6	11 14	8 9	11 7	8 3	13 7	9 17	14 10	7 8
2	3½ cwts. Superphosphate (with Farmyard Manure, '71, '72, '73)	13 3	5 9	7 9	4 16	9 5	5 17	12 5	7 7	13 1	6 4
3	Without Manure (1846, and since)	5 2	1 5	3 2	2 6	3 7	2 2	2 11	2 10	3 19	2 9
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	6 10	1 8	8 16	3 6	7 10	2 0	10 12	4 16	8 2	3 11
5	3½ cwts. Superphosphate	5 19	1 7	7 10	3 6	7 6	2 8	7 15	5 4	5 17	3 6
6	3½ cwts. Superphos., 500 lbs. Sulph. Potass	5 11	1 5	8 1	2 14	8 1	1 18	9 10	4 13	7 13	3 2
7	3½ cwts. Superphos., 500 lbs. Sulph. Pot., and Amm.-salts, '71, '72, '73	6 14	1 3	9 5	2 11	8 15	1 14	11 14	4 11	8 4	3 9
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 0	1 2	7 13	2 16	6 10	2 0	7 6	4 7	3 12	2 1
	Fifth Season, 1875. Mineral Manures as in 1872, 1873, and 1874; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Without Manure, 1874 and 1875 (Farmyard Manure in '71, '72, '73)	17 5	2 11	19 18	2 14	21 0	3 6	22 7	3 12	19 13	2 11
2	3½ cwts. Superphosphate (with Farmyard Manure, '71, '72, '73)	15 11	2 2	19 18	2 18	18 17	2 18	20 9	3 5	18 10	2 1
3	Without Manure (1846, and since)	5 9	1 1	9 5	1 12	8 0	1 3	14 1	2 13	11 17	1 10
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 9	1 0	9 8	1 7	7 16	1 1	12 14	1 14	10 3	1 7
5	3½ cwts. Superphosphate	5 11	1 2	9 19	1 10	7 16	1 4	13 17	2 8	11 2	1 14
6	3½ cwts. Superphos., 500 lbs. Sulph. Potass	5 4	1 0	8 4	1 4	7 1	1 2	12 8	2 3	10 2	1 9
7	3½ cwts. Superphos., 500 lbs. Sulph. Pot. and Amm.-salts '71, '72, '73	5 11	1 1	8 2	1 6	7 6	1 1	11 17	1 17	10 6	1 11
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 15	1 0	7 4	1 2	6 1	1 4	12 2	2 11	11 12	2 13

(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) 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.

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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. According to recent experiments of Schiebler, and others, however, the percentage of the juice in the roots, reckoned from the determined percentage of dry matter in the juice, and in the roots, respectively, has been over-estimated. According to these new results, the amount of true juice will average more nearly 90, than 95 per cent. If this be established, the percentage of sugar in the roots will be less (perhaps $\frac{1}{18}$ to $\frac{1}{10}$ less) than given in the Table below.

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.																			
	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.
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	12·51	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.)

	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	13·38	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.)

	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		16·34	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 Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

	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	0·933	
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	0·752		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		15·56	..	0·903		17·74	..	0·784		16·08	..	0·907		15·50	..	0·868	
8	18·76	..	0·726		15·30	..	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 Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

	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		15·88	..	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 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. According to recent experiments of Schiebler, and others, however, the percentage of the juice in the roots, reckoned from the determined percentage of dry matter in the juice, and in the roots, respectively, has been over-estimated. According to these new results, the amount of true juice will average more nearly 90, than 95 per cent. If this be established, the percentage of sugar in the roots will be less (perhaps $\frac{1}{18}$ to $\frac{1}{20}$ less) than given in the Table below.

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.				
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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.																			
	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.
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	12·51	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.)

	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	13·38	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.)

	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 Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

	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	0·933	
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	0·752		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		15·56	..	0·903		17·74	..	0·784		16·08	..	0·907		15·50	..	0·868	
8	18·76	..	0·726		15·30	..	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 Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

	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		15·88	..	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.

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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 (3). 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.	Roots.	Leaves.	Roots.	Leaves.
		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)	19 12	4 9	25 2	7 5	29 19	7 12	31 9	10 5	24 9	5 19
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	19 13	4 6	27 13	7 3	29 8	7 10	30 18	9 16	29 19	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	3½ cwts. 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	3½ cwts. Superphosphate	7 10	1 14	21 0	5 14	13 10	5 1	17 2	7 14	17 17	5 17
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass	6 16	1 12	21 2	5 8	17 15	4 13	26 8	9 0	20 10	5 4
7	3½ cwts. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (2)	8 13	2 3	22 11	5 14	19 2	5 11	27 2	9 9	20 12	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
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..	..	..	..	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. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
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
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	16 14	1 19	26 8	3 12	26 18	4 6	28 15	5 9	24 12	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
4	3½ cwts. 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
5	3½ cwts. Superphosphate	6 1	0 19	20 5	3 1	12 2	2 10	15 3	3 8	15 3	2 2
6	3½ cwts. 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
7	3½ cwts. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (2)	7 0	1 3	22 2	3 16	16 13	2 7	25 15	5 0	20 13	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
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..	..	..	..	13 17	4 0	..	..	..	..

Third Season, 1878. Seed dibbled, June 8–9 (Plot 9, June 11th). Crop taken up, Nov. 7–20.

		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)	13 5	2 16	18 15	4 4	20 11	5 6	22 4	6 3	17 1	3 13
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	14 16	2 19	21 4	4 15	19 15	5 3	20 18	5 17	18 17	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
4	3½ cwts. 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
5	3½ cwts. Superphosphate	4 14	1 8	14 11	3 18	8 2	3 6	8 4	3 3	8 1	3 6
6	3½ cwts. 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
7	3½ cwts. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (2)	5 8	1 9	13 18	3 1	11 18	2 18	14 0	4 5	11 19	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
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..	..	..	..	15 17	5 9	..	..	..	..

Fourth Season, 1879. Seed dibbled, May 13–15. Crop taken up, Nov. 11–20.

		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 3	1 15	9 8	2 9	12 6	3 11	13 16	3 15	10 14	2 12
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	6 13	1 16	11 11	2 18	11 12	3 9	14 1	3 17	9 18	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
4	3½ cwts. 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
5	3½ cwts. Superphosphate	1 18	0 14	8 5	2 9	5 0	1 16	9 13	3 5	6 11	1 12
6	3½ cwts. 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
7	3½ cwts. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (2)	1 18	0 14	8 2	2 6	6 7	1 14	11 2	3 6	8 4	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
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..	..	..	..	9 7	2 19	..	..	..	..

Fifth Season, 1880. Seed dibbled, April 22–23 (Plot 9, April 24th). Crop taken up, Nov. 2–11.

		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)	18 11	2 14	26 8	3 5	25 4	5 10	27 3	6 1	27 5	4 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	17 8	2 0	27 16	3 14	25 15	5 10	26 0	5 12	27 9	4 3
3	Without Manure (1846, and since)	4 10	0 18	14 0	2 13	9 17	2 11	11 4	3 0	12 6	2 9
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 17	0 19	23 6	3 3	19 14	2 18	30 11	5 12	24 4	3 6
5	3½ cwts. Superphosphate	5 3	0 16	18 6	2 4	9 18	2 13	12 9	2 18	14 8	2 13
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potass	4 15	0 14	21 10	2 11	18 12	3 4	27 4	5 11	21 8	2 7
7	3½ cwts. Superphos., 500 lbs. Sulphate Potass, 36½ lbs. Am.-salts (2)	7 0	0 19	21 10	2 6	19 6	2 19	26 0	5 6	23 2	2 11
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 0	0 17	11 14	3 5	5 19	2 17	12 4	3 1	12 1	2 15
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..	..	..	..	20 19	4 0	..	..	..	..

(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.

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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. According to the recent experiments of Schiebler, and others, on Sugar-beet, the percentage of juice in the roots, reckoned from the determined percentage of dry matter in the juice, and in the roots, respectively, has been over-estimated. According to these new results, and supposing them to apply to mangolds, the amount of true juice would average not much more than 90, instead of 96 per cent.; and if so the percentage of sugar in the roots will be less (perhaps from $\frac{1}{15}$ to $\frac{1}{20}$ less) than given in the Table below. 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); and in some cases the amount as amides and as nitric acid. 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.																			
Plots.	Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
	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.
1	12·14	7·14	0·969		10·54	..	1·031		10·65	..	1·080		8·98	..	1·065		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	..	1·005	
3	15·14	..	0·828		11·94	..	0·903		12·16	..	0·904		11·60	..	0·811		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	
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	
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	
7	13·63	..	0·882		11·61	..	0·922		10·62	..	0·969		10·66	..	1·015		11·58	..	0·936	
8	13·06	..	0·900		11·23	..	0·945		11·43	..	0·905		10·20	..	0·856		11·61	..	0·757	
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	
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	
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	
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	
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	
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	
7	15·88	..	0·943		12·74	..	1·034		13·96	..	1·098		12·58	..	1·136		13·83	..	1·036	
8	16·23	..	0·933		14·01	..	1·023		14·95	..	0·932		14·51	..	0·811		14·87	..	0·807	
9	..	..	..	..	..	..	..	..	14·84	10·01	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
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	10·50	5·94	0·987	0·217	10·66	6·14	0·948	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
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
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
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
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
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	13·54	8·32	1·064	0·186	14·40	9·24	0·995	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
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
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
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
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	12·65	8·30	0·841	0·126	10·72	6·00	0·942	0·186	11·23	6·82	0·871	0·172	11·26	6·77	0·877	0·212	12·08	7·17	0·877	0·176
2	12·87	8·06	0·850	0·136	10·44	5·88	0·986	0·188	11·68	7·03	0·891	0·189	10·47	6·33	0·948	0·220	11·66	7·13	0·855	0·171
3	17·02	11·78	0·739	0·142	12·18	7·36	0·874	0·217	14·48	9·21	0·746	0·272	11·75	7·10	0·716	0·225	12·95	8·32	0·690	0·203
4	14·05	9·87	0·756	0·082	12·36	8·11	0·847	0·136	12·23	8·23	0·849	0·119	10·77	6·53	0·883	0·151	11·18	7·19	0·869	0·123
5	13·72	9·44	0·709	0·100	11·50	6·90	0·819	0·173	12·84	8·47	0·709	0·158	10·72	6·61	0·679	0·192	12·27	7·84	0·676	0·165
6	14·04	9·59	0·761	0·097	11·86	7·47	0·807	0·153	12·40	7·96	0·878	0·123	12·16	7·47	0·837	0·188	13·17	8·68	0·745	0·151
7	13·63	..	0·798		11·64	..	0·862	0·154	12·14	..	0·863		11·68	..	0·906		12·79	..	0·742	
8	14·26	..	0·776		12·61	..	0·863		14·08	..	0·772		11·29	..	0·693		12·91	..	0·672	
9	..	..	..	..	..	..	..	..	11·32	7·15	0·801		..	..	..	..	..	..	..	..

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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 (3). 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 and 1881, 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. Good.	Small.	Diseased.	Total.	Tops.
	First Season, 1876. Potatos planted, June 10–13; Crop taken up, Oct. 30–31.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	
1	Unmanured	3 6½	0 5½	0 5¾	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 cwts. Superphosphate (1)	4 14¾	0 6¾	0 5½	5 6¾	
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	5 9¼	0 5¾	0 19½	6 14½	
5	400 lbs. Ammonia-salts (2)	2 5¼	0 6¾	0 6	2 18	
6	550 lbs. Nitrate of Soda	3 2	0 5¾	0 9⅞	3 17⅝	
(3) 7	400 lbs. Ammonia-salts, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	6 12½	0 9½	1 0	8 2	
(3) 8	550 lbs. Nitrate of Soda, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	6 17⅝	0 10	1 8½	8 15⅞	
(3) 9	3½ cwts. Superphosphate	4 18¾	0 8½	0 13¾	6 1	
(3) 10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	5 3¾	0 6¾	0 13½	6 3⅝	
	Second Season, 1877. Potatos planted, April, 27–28; Crop taken up, Oct. 8–10.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	
1	Unmanured	2 11½	0 6¾	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 0¾	0 11¼	0 6	5 18	
3	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	4 13½	0 7½	0 4	5 4¾	
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	6 18¾	0 7	0 17½	8 3½	
5	400 lbs. Ammonia-salts (2)	3 9¾	0 7½	0 4	4 1	
6	550 lbs. Nitrate of Soda	4 14¾	0 6¾	0 5¾	5 7¼	
7	400 lbs. Ammonia-salts, 3½ cwts. 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 cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	7 8½	0 8¾	0 16¾	8 13¾	
9	3½ cwts. Superphosphate	2 12¾	0 11¾	0 1½	3 6	
10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	3 6¾	0 7½	0 1¼	3 15½	
	Third Season, 1878. Potatos planted, April 29. Crop taken up, Sept. 18–21; Tops weighed, and spread on the Plots.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Unmanured	2 6¾	0 8¾	0 2	2 17½	0 3¾
2	Farmyard Manure (14 tons)	4 11	0 12½	0 8½	5 11¾	0 6¾
3	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	5 18½	0 14½	0 13¼	7 6	0 11
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	6 11¾	0 11½	1 6½	8 9¼	1 6
5	400 lbs. Ammonia-salts (2)	2 16½	0 8½	0 5¾	3 10½	0 7
6	550 lbs. Nitrate of Soda	3 16¾	0 7	0 9½	4 13½	0 11
7	400 lbs. Ammonia-salts, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	7 6¾	0 9½	1 1	8 17½	0 13¾
8	550 lbs. Nitrate of Soda, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	7 11½	0 9	1 3¾	9 4½	1 0½
9	3½ cwts. Superphosphate	3 5¾	0 9½	0 9½	3 18¾	0 4¾
10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	3 8	0 9	0 4¾	4 1¾	0 4¾
	Fourth Season, 1879. Potatos planted, May 2; Crop taken up, Oct. 13–16.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	
1	Unmanured	0 11½	0 4	0 0¾	0 16¼	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 cwts. Superphosphate (1)	1 14	0 6	0 10½	2 10½	
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	2 16	0 5¾	0 12¾	3 14½	
5	400 lbs. Ammonia-salts (2)	0 17½	0 4	0 1½	1 3	
6	550 lbs. Nitrate of Soda	0 14½	0 4½	0 2	1 0¾	
7	400 lbs. Ammonia-salts, 3½ cwts. 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 cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1 18½	0 4½	0 6½	2 9	
9	3½ cwts. Superphosphate	0 17½	0 3½	0 1½	1 2	
10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	0 16¾	0 3	0 1¾	1 1½	
	Fifth Season, 1880. Potatos planted, April 13; Crop taken up, Plots 5 and 6, Sept. 9th; other Plots, Sept. 28–30.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	
1	Unmanured	0 14½	0 6¾	0 0½	1 1¾	Withered, not weighed, each lot spread on its own Plot and ploughed in.
2	Farmyard Manure (14 tons)	4 13¼	0 6	0 5	5 4¼	
3	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	5 6¾	0 5½	0 10¾	6 2¾	
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	5 4	0 5½	1 1½	6 10¾	
5	400 lbs. Ammonia-salts (2)	0 8½	0 9½	0 0	0 17¾	
6	550 lbs. Nitrate of Soda	0 11¼	0 10	0 0	1 1¼	
7	400 lbs. Ammonia-salts, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	5 15¾	0 5¾	0 13	6 14	
8	550 lbs. Nitrate of Soda, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	6 3½	0 6¾	1 1	7 11¼	
9	3½ cwts. Superphosphate	3 9	0 6¾	0 3¼	3 19	
10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	3 7¼	0 6	0 3½	3 16½	

(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.

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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. In the tubers the dry matter, nitrogen, and ash have been determined; and in some cases complete analyses of the ash have been made. Besides the results obtained relating to the composition of the tubers themselves, the dry matter, the sugar, the nitrogen, and the ash in the expressed juice have in many cases been determined; in some cases the amount of the nitrogen existing as albumenoids has been determined; and in some, complete analyses of the ash of the juice have been made. 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 potatos have been submitted to the same methods of analysis as the good potatos. 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 potatos. With regard to these latter results, it may be observed, that whilst the juice of the white portion of the diseased potatos 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 sugar found in the diseased potatos, the result of diseased action, and it probably also contributed to the development of the fungus.

The results given in the Table relate to the "good" potatos 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.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Unmanured	1·097	23·9	0·84	3·53	0·273	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 cwts. Superphosphate (1)	1·097	23·5	1·00	4·27	0·193	0·83
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	1·085	21·2	0·83	3·92	0·299	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 cwts. 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 cwts. 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 cwts. Superphosphate	1·103	23·5	1·10	4·72	0·201	0·86
10	3½ cwts. 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.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Unmanured	1·119	33·0	1·05	3·17	0·302	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 cwts. Superphosphate (1)	1·103	26·0	1·11	4·26	0·207	0·80
4	Farmyard Manure (14 tons), 3½ cwts. 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 cwts. 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 cwts. 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 cwts. Superphosphate	1·109	26·5	1·18	4·44	0·203	0·76
10	3½ cwts. 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.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Unmanured	1·107	26·0	0·85	3·26	0·228	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 cwts. Superphosphate (1)	1·090	23·8	1·03	4·35	0·205	0·86
4	Farmyard Manure (14 tons), 3½ cwts. 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 cwts. 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 cwts. 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 cwts. Superphosphate	1·097	24·1	1·14	4·74	0·165	0·68
10	3½ cwts. 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.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Unmanured	1·103	24·3	0·96	3·95	0·242	1·00
2	Farmyard Manure (14 tons)	1·103	23·7	0·99	4·16	0·220	0·93
3	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	1·099	24·0	1·02	4·26	0·218	0·91
4	Farmyard Manure (14 tons), 3½ cwts. 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	3·06	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 cwts. 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 cwts. 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 cwts. Superphosphate	1·099	23·6	1·10	4·65	0·219	0·93
10	3½ cwts. 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.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Unmanured	1·123	28·8	0·77	2·66	0·382	1·33
2	Farmyard Manure (14 tons)	1·114	27·6	0·98	3·56	0·287	1·04
3	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	1·117	27·8	0·98	3·52	0·275	0·99
4	Farmyard Manure (14 tons), 3½ cwts. Superphosphate, and 550 lbs. Nitrate of Soda	1·102	25·2	0·88	3·48	0·357	1·41
5	400 lbs. Ammonia-salts (2)	1·114	28·5	0·84	2·95	0·430	1·51
6	550 lbs. Nitrate of Soda	1·117	28·8	0·88	3·06	0·415	1·44
7	400 lbs. Ammonia-salts, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1·097	25·9	0·97	3·73	0·327	1·26
8	550 lbs. Nitrate of Soda, 3½ cwts. Superphos., 300 lbs. Sulph. Potass, 100 lbs. Sulph. Soda, 100 lbs. Sulph. Mag.	1·118	26·7	0·96	3·59	0·318	1·19
9	3½ cwts. Superphosphate	1·114	27·2	1·03	3·81	0·247	0·91
10	3½ cwts. Superphosphate, 300 lbs. Sulphate Potass, 100 lbs. Sulphate Soda, and 100 lbs. Sulphate Magnesia	1·116	27·3	1·06	3·86	0·236	0·87

(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.

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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 (1881) is the 34th experimental one, or the second 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 in 1874; the other half of each being left fallow. In the Eighth Course beans were again grown. For the Ninth Course (Spring 1881) clover has been sown.

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 avoir.) 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. Corn[3] (or Roots).	Plot 1. Straw (or Leaf).	Plot 1. Total Produce.[4]	Plot 2. Superphosphate of Lime,[1] alone, for the Turnip Crops only. Corn[3] (or Roots).	Plot 2. Straw (or Leaf).	Plot 2. Total Produce.[4]	Plot 3. Complex Manure,[2] for the Turnip Crops only. Corn[3] (or Roots).	Plot 3. Straw (or Leaf).	Plot 3. Total Produce.[4]
1st Course, 1848–51.										
1848	Norfolk White Turnips	6½ cwts.	45⅝ cwts.	111¼ cwts.	225½ cwts.	106¼ cwts.	332 cwts.	218 cwts.	151⅛ cwts.	369¾ cwts.
1849	Barley	44⅝ bush.	2983 lbs.	5636 lbs.	29⅜ bush.	2111 lbs.	3841 lbs.	29⅞ bush.	2088 lbs.	3794 lbs.
1850	Clover (calc[4]. as hay)	..	..	54 cwts.	..	..	57¾ cwts.	..	..	63 cwts.
1851	Wheat	28½ bush.	3431 lbs.	5389 lbs.	28 bush.	3371 lbs.	5233 lbs.	28⅛ bush.	3552 lbs.	5500 lbs.
2nd Course, 1852–55.										
1852	Swedish Turnips	26 cwts.	4½ cwts.	30½ cwts.	223½ cwts.	20½ cwts.	243½ cwts.	396½ cwts.	36½ cwts.	433 cwts.
1853	Barley	34⅜ bush.	2430 lbs.	4465 lbs.	28⅜ bush.	1873 lbs.	3560 lbs.	38½ bush.	2604 lbs.	4873 lbs.
1854	Beans	5½ bush.	1055 lbs.	1445 lbs.	5⅞ bush.	1103 lbs.	1534 lbs.	9⅛ bush.	1355 lbs.	2065 lbs.
1855	Wheat	35¼ bush.	3619 lbs.	5859 lbs.	35½ bush.	3525 lbs.	5789 lbs.	37½ bush.	3942 lbs.	6371 lbs.
3rd Course, 1856–59.										
1856	Swedish Turnips	32 cwts.	2½ cwts.	34½ cwts.	136 cwts.	7½ cwts.	142½ cwts.	333¾ cwts.	12½ cwts.	346¼ cwts.
1857	Barley	48½ bush.	2600 lbs.	5337 lbs.	22½ bush.	1475 lbs.	3076 lbs.	48 bush.	2435 lbs.	5163 lbs.
1858	Beans	6½ bush.	1100 lbs.	1515 lbs.	6½ bush.	1155 lbs.	1605 lbs.	12⅜ bush.	1520 lbs.	2357 lbs.
1859	Wheat	35¼ bush.	4030 lbs.	6262 lbs.	34⅜ bush.	3930 lbs.	6129 lbs.	39⅝ bush.	4610 lbs.	7154 lbs.
4th Course, 1860–63.										
1860	Swedish Turnips	1 cwt.	(6¼ lbs.)	1 cwt.	29½ cwts.	1¼ cwt.	30⅞ cwts.	87½ cwts.	3¼ cwts.	90¾ cwts.
1861	Barley	38⅜ bush.	2522 lbs.	4718 lbs.	30⅜ bush.	2000 lbs.	3775 lbs.	60⅜ bush.	3940 lbs.	7391 lbs.
1862	Beans	29 bush.	1840 lbs.	3661 lbs.	29⅜ bush.	2150 lbs.	4040 lbs.	43⅜ bush.	3280 lbs.	5990 lbs.
1863	Wheat	34½ bush.	3467 lbs.	5625 lbs.	34⅞ bush.	3390 lbs.	5619 lbs.	46½ bush.	4697 lbs.	7626 lbs.
5th Course, 1864–67.										
1864	Swedish Turnips	8½ cwts.	0⅜ cwt.	9½ cwts.	68 cwts.	4¾ cwts.	72¾ cwts.	176½ cwts.	8⅜ cwts.	185 cwts.
1865	Barley	39 bush.	2154 lbs.	4182 lbs.	33½ bush.	1615 lbs.	3394 lbs.	47⅓ bush.	2595 lbs.	5148 lbs.
1866	Beans	10½ bush.	1013 lbs.	1629 lbs.	7⅜ bush.	978 lbs.	1463 lbs.	20⅜ bush.	1990 lbs.	3343 lbs.
1867	Wheat	21 bush.	2143 lbs.	3473 lbs.	19⅜ bush.	1966 lbs.	3222 lbs.	23⅜ bush.	3003 lbs.	4567 lbs.
6th Course, 1868–71.										
1868	Swedish Turnips	Failed, and ploughed up.			Failed, and ploughed up.			Failed, and ploughed up.		
1869	Barley	24⅜ bush.	1948 lbs.	3358 lbs.	28⅜ bush.	2025 lbs.	3686 lbs.	42½ bush.	3309 lbs.	5800 lbs.
1870	Beans	13⅜ bush.	738 lbs.	1591 lbs.	15⅝ bush.	768 lbs.	1778 lbs.	24⅜ bush.	1056 lbs.	2664 lbs.
1871	Wheat	20⅝ bush.	2799 lbs.	4092 lbs.	23⅞ bush.	3048 lbs.	4521 lbs.	24 bush.	3440 lbs.	4942 lbs.
7th Course, 1872–75.										
1872	Swedish Turnips	34½ cwts.	8⅜ cwts.	42⅞ cwts.	170¼ cwts.	17⅝ cwts.	188 cwts.	339⅞ cwts.	35½ cwts.	375⅝ cwts.
1873	Barley	23½ bush.	1343 lbs.	2717 lbs.	20¾ bush.	1505 lbs.	2875 lbs.	31½ bush.	1723 lbs.	3573 lbs.
1874	Clover	..	..	81⅜ cwts.	..	..	82⅜ cwts.	..	..	84¼ cwts.
1875	Wheat	21⅛ bush.	2430 lbs.	3784 lbs.	28⅛ bush.	3536 lbs.	5328 lbs.	31⅛ bush.	4685 lbs.	6699 lbs.
8th Course, 1876–79.										
1876	Swedish Turnips	17½ cwts.	5 cwts.	22½ cwts.	182½ cwts.	28½ cwts.	210¾ cwts.	356 cwts.	55¼ cwts.	411¼ cwts.
1877	Barley	23½ bush.	1291 lbs.	2623 lbs.	24⅝ bush.	1174 lbs.	2558 lbs.	34¾ bush.	1918 lbs.	3890 lbs.
1878	Beans	8⅜ bush.	740 lbs.	1301 lbs.	7⅜ bush.	1045 lbs.	1557 lbs.	20½ bush.	1655 lbs.	2863 lbs.
1879	Wheat	10⅜ bush.	1324 lbs.	1987 lbs.	14⅜ bush.	1771 lbs.	2729 lbs.	13 bush.	1658 lbs.	2493 lbs.
9th Course, 1880–83.										
1880	Swedish Turnips	14 cwts.	2¼ cwts.	16¼ cwts.	199¼ cwts.	11¾ cwts.	211¼ cwts.	439¼ cwts.	43¼ cwts.	482⅜ cwts.
1881	Barley									
1882	Clover or Beans									
1883	Wheat									
Summary—Average of the First 8 Courses, 1848-1879.										
1848, '52, '56, '60, '64, '72, '76	Swedish Turnips	26⅜ cwts.	9¼ cwts.	35⅝ cwts.	148⅜ cwts.	26⅝ cwts.	175⅛ cwts.	272½ cwts.	43⅜ cwts.	315⅝ cwts.
1849, '53, '57, '61, '65, '69, '73, '77	Barley	34⅜ bush.	2159 lbs.	4132 lbs.	28½ bush.	1730 lbs.	3346 lbs.	41⅜ bush.	2577 lbs.	4955 lbs.
1850, '54, '58, '62, '66, '70, '74, '78	Clover, 1850 and '74 (calc[4]. as hay)	..	..	42⅞ cwts.	..	..	55 cwts.	..	..	73⅝ cwts.
	Beans	12½ bush.	1081 lbs.	1867 lbs.	12½ bush.	1200 lbs.	1996 lbs.	21⅞ bush.	1809 lbs.	3230 lbs.
1851, '55, '59, '63, '67, '71, '75, '79	Wheat	25⅞ bush.	2905 lbs.	4559 lbs.	27⅜ bush.	3067 lbs.	4823 lbs.	30⅛ bush.	3698 lbs.	5669 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. Rape-Cake; Second Course—300 lbs. Sulphate of Potass, 100 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 160 lbs. Bone-ash, 120 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake; Third, Fourth, Fifth, Sixth, Seventh, Eighth, and Ninth Courses—300 lbs. Sulphate of Potass, 200 lbs. Sulphate of Soda, 100 lbs. Sulphate of Magnesia, 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid, 100 lbs. Sulphate of Ammonia, 100 lbs. Muriate of Ammonia, and 2000 lbs. Rape-cake, *per acre*.

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

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

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Experiments with Different Descriptions of WHEAT, in 1881; and Summary of Results obtained in previous Years.

Season 1881. Rickyard Field. 1½ Cwt. Nitrate Soda, after Mangolds (with Dung and Guano) Carted off.	1871; Sawpit Field; 3 cwts. Guano; after Mangolds, carted off.	1872; Foster's Field; 2 cwts. Superphosphate, 2 cwts. Nitrate Soda; after Roots, carted off.	1873; Long Hoos Field; 1½ cwt. Nitrate; after Mangolds (with Dung), carted off.	1874; Upper Harpenden Field; 2 cwts. Nitrate; after Mangolds (with Dung) carted off.	1875; Little Knott-Wood Field; 1½ cwt. Nitrate Soda; after Mangolds (with Dung), 1874, carted off.	1876; Harpenden Field; 2 cwts. Nitrate Soda; after Mangolds (with Dung) 1875, carted off.	1877; Sawpit Field; 1⅞ cwt. Nitrate Soda; after Mangolds (with Dung) 1876, carted off.	1878; Foster's Field; 2 cwts. Nitrate, after White Turnips (with Dung and Artificial) 1877, part Fed, part carted off.	1879; (1) Little Knott-Wood Field; 2 cwts. Nitrate; after Clover. First and second Crops, as Hay; afterwards Fed.	1880; (2) Harpenden Field; 50 bushels of Soot; after Clover unmanured. One Crop as Hay; afterwards Fed.	1881; Rickyard Field; 1½ cwt. Nitrate Soda; after Mangolds (with Dung and Guano 1880) carted off.	1882;	(3) Averages, up to 1878 inclusive.	Nos.
DRESSED CORN PER ACRE. Bushels.														
1. White-chaff (Red)	.. ..	.. ..	40⅝	55⅛	40¼	49½	48⅜	59	22⅜	28⅛			48⅞	1
2. Rivett's (Red)	.. ..	.. ..	48⅛	67	48⅜	42½	49⅜	66⅛	16	22⅜			53⅜	2
3. Chubb Wheat (Red)	28⅜	40	35⅜	50½	38¼	40¼	41½	55⅛	20¾	14⅞			41¼	3
4. Red-chaff (White)	32¾	37	35¼	48⅜	34¼	43⅜	41	.. ..	.. ..	.. ..			39	4
5. Browick (Red)	35¼	40½	38½	51⅛	38½	39⅛	40⅞	49½	24	19⅜			41⅜	5
6. Red Wonder	31¼	43⅜	37⅛	55⅛	33¼	44¼	41⅜	52⅛	22	28¼			42⅜	6
7. Burwell (Old Red Lammas)	31⅛	41¼	35⅛	47¼	38½	38⅜	39	46¼	27	27			39⅜	7
8. Bristol Red	29⅜	44⅜	39½	53⅜	31⅜	42⅜	44½	52⅛	21⅜	30⅜			42⅜	8
9. Red Nursery	34⅛	45¼	27⅛	41⅛	39	37½	40⅜	47⅜	30⅞	27½			39½	9
10. Red Langham	30¾	43⅜	34⅛	53⅛	34⅞	42½	42⅞	50⅜	25¾	28⅜			41⅜	10
11. Woolly Ear (White)	31¼	42⅜	37	51½	36⅛	46⅜	37½	48¼	20	21			41⅜	11
12. Hardcastle (White)	.. ..	46½	42	49⅝	33⅞	44	42½	54	21½	24⅜			44⅜	12
13. Golden Drop (Red), Hallett's	39½	49⅜	44¼	51⅜	38½	48⅜	49½	52⅜	21	18⅞			46⅜	13
14. Victoria White, Hallett's	33⅜	45½	38¼	44¼	33⅜	41⅛	42⅜	43⅞	14⅞	15¾			40⅜	14
15. Hunter's White, Hallett's	26⅞	39¾	38⅜	45⅜	26⅜	43½	40	42¾	17⅜	22⅜			37⅞	15
16. Original Red, Hallett's	30	35¼	36⅜	43⅜	26	40½	44⅜	.. ..	.. ..	.. ..			36½	16
17. White Chiddam	26⅞	38⅜	31⅜	42	32⅜	37½	37⅝	49⅜	11⅞	27⅜			37½	17
18. Red Rostock	37	.. ..	46½	53⅜	37⅜	40	46⅜	57	8½	28⅜			45⅓	18
19. Casey's White	29⅞	42½	37½	52½	39	45½	43	47⅜	15⅜	24½			42⅜	19
20. Golden Rough-chaff (Red)	33	39¼	38½	52½	38¾	38⅜	36⅜	46¾	14⅜	31¼			40⅜	20
21. Bole's Prolific (Red)	33⅝	42⅜	45¼	48⅛	43⅜	41⅜	44⅜	52¾	31	24½			44	21
22. Club Wheat (Red)	36	45⅜	47½	59⅜	46⅜	47⅜	49½	61	23½	16⅜			49½	22
23. Main's Standing White	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	50⅛	32⅛	16½			50⅛	23
24. Main's Rough-chaff (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	50⅝	24	15⅞			50⅜	24
25. Belgian (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	52½	21¾	9⅜			52⅜	25
26. Webb's Challenge (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	30¼			.. ..	26
Means	32¼	42¼	38⅞	50¾	36⅜	42⅜	42⅞	51¾	21¼	23⅛			43½	Means.
WEIGHT PER BUSHEL. Lbs.														
1. White-chaff (Red)	.. ..	.. ..	58½	61⅝	61	63	60⅜	60⅞	51⅞	54⅜			61	1
2. Rivett's (Red)	.. ..	.. ..	57⅛	58⅛	58⅛	59⅞	60¼	58⅞	49⅛	55⅞			58¾	2
3. Chubb Wheat (Red)	60¼	61⅞	59⅛	61⅛	59⅓	62⅞	60½	61½	53	53¾			60⅜	3
4. Red-chaff (White)	61⅝	62¼	60⅜	61½	60½	63½	60½	.. ..	.. ..	.. ..			61⅜	4
5. Browick (Red)	60	61⅜	59½	61¼	59⅞	62⅓	60⅜	62½	52⅜	54⅞			61	5
6. Red Wonder	59	60⅞	60	62¼	60⅜	63	61¼	63	52⅜	56⅜			61¼	6
7. Burwell (Old Red Lammas)	62	63	61⅜	63⅜	61⅜	64⅜	61½	64	55¼	58½			62⅝	7
8. Bristol Red	60⅞	61¼	60½	61⅜	60⅓	62⅜	59⅜	63½	54⅜	57⅓			61¼	8
9. Red Nursery	63	65	62	65¼	62¼	66	58⅜	62⅜	57¼	59⅜			63⅛	9
10. Red Langham	60⅜	61¼	60½	63	60⅜	63⅜	61¼	63½	54½	56⅜			61⅜	10
11. Woolly Ear (White)	61½	62½	61⅛	62¾	57⅜	63⅜	59⅞	62½	52½	55⅜			61⅜	11
12. Hardcastle (White)	.. ..	61⅞	59⅜	63	59⅞	63½	59⅞	61½	52⅜	55⅜			61⅜	12
13. Golden Drop (Red), Hallett's	61⅜	63	59⅜	63	61½	64⅜	61⅜	63½	52⅜	55⅜			62½	13
14. Victoria White, Hallett's	61	62⅜	59⅜	62¼	61⅜	63⅜	61	61⅜	51½	56¼			61⅜	14
15. Hunter's White, Hallett's	59¼	61⅜	57¼	61½	60½	63⅝	59¼	62½	55	59¼			60⅜	15
16. Original Red, Hallett's	58⅝	60	56½	60⅜	58½	62⅜	59	.. ..	.. ..	.. ..			59⅜	16
17. White Chiddam	62¼	63	59¼	62⅜	61⅜	64⅝	61½	61⅜	54½	58			62	17
18. Red Rostock	60⅜	.. ..	56⅜	59⅞	59⅜	63½	59⅜	60¼	54	56⅜			59⅞	18
19. Casey's White	60⅜	61⅝	58⅜	60⅜	60	63½	59⅜	60⅜	55⅜	58½			60⅝	19
20. Golden Rough-chaff (Red)	61⅝	62½	59⅜	62½	61⅜	65½	60⅜	61⅜	54½	57⅜			62	20
21. Bole's Prolific (Red)	61½	62⅜	57½	62	60⅞	63⅞	60½	63½	55½	55⅞			61½	21
22. Club Wheat (Red)	60⅜	61⅞	58¼	61⅞	61⅜	63¼	59⅜	62½	52⅞	55⅜			61½	22
23. Main's Standing White	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	61⅜	56¼	57½			61⅜	23
24. Main's Rough-chaff (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	61⅜	53½	56½			61⅜	24
25. Belgian (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	60⅜	51⅜	53⅞			60¾	25
26. Webb's Challenge (White)	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	59⅛			.. ..	26
Means	60¾	62⅛	59¼	61⅞	60¼	63½	60¼	62	53½	56⅜			61¼	Means.

(1) 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.

(2) Owing doubtless in great part to the imperfect development of the grain from the crop of 1879, much of the wheat sown for the crop of 1880 did not germinate at all, and of that which did come up a great deal was afterwards destroyed by wire-worm, so that up to the end of March it was a question whether there would be a plant left in the field worth saving. With the thin wheat plant there was an extraordinary growth of weeds, which the wet month of July much favoured, and made it impossible to keep under. The white wheats appeared to suffer most either from imperfectly developed seed, wire-worm, or blight. The most satisfactory crop was "Webb's Challenge," the seed for which was obtained direct from the seedsman, not grown on the farm, as were the others.

(3) Owing to the produce of 1879 and 1880 being so exceptionally bad, that of those years is not included in the averages.

ROTHAMSTED

MAY

SUMMARY STATEMENT OF THE PRESENT AND PREVIOUS

(13 Years, 1869–1881,

Name of Field.	Acres.	PREVIOUS CROPPING						
		1869.	1870.	1871.	1872.	1873.	1874.	1875.
Thirty Acres	30	**Wheat,** 2 cwts. Guano.	**Oats,** 2 cwts. Guano.	**Barley,** 2 cwts. superphos., 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda, (2½ acres experimt.).	**Barley** (¾ with Grass-seeds). 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Grass** (¾), Folded, and 1 cwt. Nitrate. **Barley** (¼), 2 cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Grass** (¾), Sheep-folded. **Tares** (¼) Dung.
Harpenden	22	**Swedes,** Dung and various Artificial Manures.	**Wheat,** 3 cwts. Guano.	**Oats,** 3 cwts. Guano, 1 cwt. Nitrate Soda. **Tares,** Dung.	**Oats,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda. **Tares,** Dung.	**Barley,** After Oats—2 cwts. superphosphate; 2 cwts. Nitrate. After Tares—1 cwt. superphosphate; 1 cwt. Nitrate.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Mangolds,** Dung, and 2 cwts. Guano. (Carted off.)
Little Hoos	9	**Barley,** 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia, 1 cwt. superphosphate.	**Barley,** 2½ cwts. Guano.	**Barley,** 3 cwts. superphos., 2½ cwts. Nitrate Soda.	**Barley** (with Clover). 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Barley** (½), Unmanured. **Clover** (½), Unmanured.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda (1 acre Unmanured).	**Barley,** where Barley 1873, 2 cwts. superphosphate, 2 cwts. Nitrate of Soda. where Clover 1873, Half quantities.
Fosters' ..	18	**Barley,** 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia, 1 cwt. superphosphate.	**Oats,** 2 cwts. Guano, 3 cwts. Blood Manure.	**Roots, Tares, and Rape,** Dung and Artificial.	**Wheat,** ⅓ Varieties of Wheat, 2 cwts. superphos., 2 cwts. Nitr. Soda, ⅔ Sheep-folded.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda. (2 acres experiment).	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** (½) 3½ cwts. Guano, (½) 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda, (½) 1½ cwts. Guano, 1½ Nitrate.
Knott Wood	30	**Wheat,** 3 cwts. Guano (one-half), Unmanured (one-half), after Swedes ploughed up and Fallowed.	**Oats,** 3 cwts. Guano.	**Oats,** 3 cwts. Guano, 1 cwt. Nitrate Soda.	**Oats,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Tares** (¼), Dung. **Swedes** (¾), Dung, 2 cwts. superphosph.; 2 cwts. Nitrate Soda.	**Barley,** After Roots and Tares carted, 2 cwts. superphosphate, 2 cwts. Nitrate Soda, After Tares fed, 1 cwt. each.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.
Little Knott Wood ..	14	**Mangolds,** 12 tons Dung, 3 cwts. Guano.	**Wheat,** 3 cwts. Guano.	**Oats,** 3 cwts. Guano, 1 cwt. Nitrate Soda.	**Oats,** ½ Sheep-folded. All, 2½ cwts. super., 2½ cwts. Nitr. Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Mangolds,** Dung. (Carted off.)	**Wheat** (Varieties), 1½ cwt. Nitrate Soda.
Sawpit ..	14	**Wheat,** 3 cwts. Guano.	**Mangolds,** Dung and 3 cwts. Guano.	**Wheat,** 3 cwts. Guano.	**Oats,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Oats,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.
Rick-yard	8	**Tares,** Dung.	**Barley,** 1 cwt. Guano.	**Mangolds,** Dung and 4 cwts. Cotton Cake.	**Wheat,** Unmanured.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Tares,** Dung. ½ followed by Turnips, 1 cwt. superphosphate, 1 cwt. Nitrate Soda.	**Barley,** 1 cwt. Nitrate Soda.
Six Acres ..	6	**Wheat,** 2 cwts. Guano, 1 cwt. Nitrate of Soda.	**Barley,** 2½ cwts. Guano.	**Barley,** 3 cwts. superphos., 2½ cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2½ cwts. Nitrate Soda.
Clay-Croft	12	**Oats,** 2 cwts. Guano, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia.	**Turnips,** Dung and 3 cwts. superphosphate.	**Wheat,** Unmanured.	**Oats,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Clover,** Unmanured.	**Wheat,** 2 cwts. Nitrate Soda.	**Oats,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.
Ten Acres ..	10	**Wheat,** 2 cwts. Guano.	**Oats,** 3 cwts. Guano.	**Mangolds,** Dung and 4 cwts. Cotton Cake.	**Wheat,** Unmanured.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda (5 acres experiment).	**Oats,** 2 cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Oats,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.
Agdell ..	9	**Barley,** Unmanured.	**Barley,** 1½ cwt. Guano, 1½ cwt. superphosphate.	**Mangolds,** Dung and 4 cwts. Cotton Cake.	**Wheat,** Unmanured (and part Roots).	**Clover,** Unmanured. **Barley,** Experiment.	**Wheat,** 1 cwt. Nitrate Soda (3 acres Experiment, ¼ Clover, ¼ Fallow).	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda. **Wheat,** 3 acres, Experiment.
Long Hoos	25	**Oats,** 2 cwts. Guano, 1 cwt. dried Blood, ½ cwt. Sulph. Ammonia.	**Sainfoin,** Unmanured.	**Sainfoin,** Unmanured. (Steam cultivated, July.)	**Mangolds,** Dung. (Carted off.)	**Wheat,** (⅓ Varieties of Wheat), 1½ cwt. Nitrate Soda.	**Oats,** 2 cwts. superphosphate, 2 cwts, Nitrate Soda.	**Oats,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.
Sawyers' ..	25	**Fallow.**	**Wheat,** 4 cwts. Guano.	**Wheat,** 4 cwts. Guano. 1 cwt. Nitrate Soda.	**Barley,** 2½ cwts. superphos., 2½ cwts. Nitr. Soda.	**Oats,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Mangolds and Swedes,** Dung.	**Barley after Swedes** (¾) 2 cwts. superphosphate, 2 cwts. Nitrate Soda. **Wheat after Mangolds** (¼) 1½ cwt. Nitrate Soda.
West Barn	30	**Wheat,** 3 cwts. Guano.	**Sainfoin,** Unmanured.	**Sainfoin,** Unmanured.	**Sainfoin,** Unmanured.	**Oats,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Wheat** (Oats fed off 1873), 1½ cwt. Nitrate Soda.	**Oats,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.

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FARM.

1881.

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

inclusive.)

AND MANURING.					Crops, &c., Present Season, 1880–'81.	Acres.	Name of Field.
1876.	1877.	1878.	1879.	1880.			
Grass (¾), Compost. **Wheat** (¼), 1 cwt. Nitrate Soda.	**Grass** (¾), Cattle Grazed. **Barley** (¼), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Grass** (¾), Cattle Grazed with Cotton-Cake. **Tares** (½), Dung.	**Grass** (¾), Cattle Grazed with Cotton-Cake. **Barley** (¼), 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Grass** (¾), Cattle Grazed with Cotton-Cake. **Fallow** (¼).	**Grass** (¾), Cattle Grazed with Cotton-Cake, Hay, and Mangolds. **Oats** (¼), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	30	Thirty Acres
Wheat (Varieties), 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley** (with Clover), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Clover,** Unmanured. One Crop as Hay.	**Wheat** (½), (Varieties). 50 bushels Soot. **Mangolds** (½), 15 tons Dung & 3 cwts. Guano. (Carted off).	**Fallow** (½). **Wheat** (½), 1½ cwts. Nitrate Soda.	22	Harpenden.
Barley, 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda (½ with Clover).	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda (½ with Clover).	**Barley** (½), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda. **Clover** (½), Unmanured. Two Crops as Hay.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. Guano.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda. (½ with Clover).	9	Little Hoos.
Barley, 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**White Turnips,** Dung. Superphosphate, ½ cwt. Nitrate Soda; part fed, part carted.	**Wheat** (Varieties). 2 cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. Guano.	**Fallow.**	18	Fosters'.
Oats, 2½ cwts. superphosphate, 3 cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Roots** (½), Dung and Artificial. (Carted off). **Fallow** (½).	**Wheat** (½), 2 cwts. Nitrate Soda. **Barley** (½), 2 cwts. superphosphate, 2 cwts. Nitrate Soda (all with Clover).	**Barley** (½), 2½ cwts. Guano. **Clover** (½), Unmanured. (⅓) 2 crops as Hay, (⅓) 1 crop as Hay, aftwds. Fed.	**Wheat,** 1½ cwts. Nitrate Soda.	30	Knott Wood.
Oats, 2½ cwts. superphosphate, 3 cwts. Nitrate Soda.	**Oats** (with Clover), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Clover,** Unmanured. First and second Crops as Hay; afterwards fed.	**Wheat** (Varieties), 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. Guano.	**Oats,** 2½ cwts. Nitrate Soda, 2½ cwts. superphosphate.	14	Little Knott Wood.
Mangolds, 25 tons Dung. (Carted off.)	**Wheat** (Varieties), 1¾ cwt. Nitrate Soda.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Fallow.**	**Mangolds,** (½) Dung 16 tons in 1880, 4 cwts. Guano in 1881, (½) Dung, 18 tons in 1881.	14	Sawpit.
Swedes, Dung, and Superphosphate.	**Barley,** 1 cwt. Nitrate Soda.	**Barley,** 2½ cwt. superphosphate, 2½ cwts. Nitrate Soda.	**Barley** (⅔), 2 cwts. superphosphate, 2 cwts. Nitrate Soda. **Fallow** (⅓),	**Mangolds,** 15 tons Dung, 3 cwts. Guano. (Carted off.)	**Wheat,** (Varieties), 1½ cwt. Nitrate Soda.	8	Rick-yard.
Barley, 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley** (with Clover), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Clover,** Unmanured. Two Crops as Hay.	**Wheat,** 2 cwts. Nitrate Soda.	**Mangolds,** 15 tons Dung, 3 cwts. Guano. (Carted off.)	**Wheat,** 1½ cwts. Nitrate Soda.	6	Six Acres.
Oats, 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Fallow.**	**Wheat,** 2 cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. Guano.	**Fallow.**	12	Clay-Croft.
Fallow.	**Wheat** (with Clover), 2 cwts. Nitrate Soda.	**Clover,** Unmanured. Two Crops as Hay.	**Barley,** 2 cwts. Nitrate Soda (with Grass Seeds).	**Grass,** Unmanured.	**Grass,** Cattle Grazed, with Cotton-Cake. Dung 15 tons.	10	Ten Acres.
Barley, 2½ cwts. superphosphate, 3 cwts. Nitrate Soda. **Swedes,** 3 acres, Experiment.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda. **Barley,** 3 acres Experiment.	**Potatos,** Dung and Artificial. (3 acres Experiment ½ Beans, ½ Fallow.)	**Barley,** 2 cwts. superphosphate, 2 cwts. Nitrate Soda (3 acres Experiment, Wheat).	**Fallow,** (3 acres Experiment, Swedes).	**Oats,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda, (3 acres Experiment, Barley).	9	Agdell.
Oats (¾), 2½ cwts. superphosphate, 3 cwts. Nitrate Soda. **Tares** (¼), Dung.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	**Barley,** 2 cwts. superphosbate, 2 cwts. Nitrate Soda.	**Barley,** 2½ cwts. Guano.	**Barley,** (with Clover). 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	25	Long Hoos.
Barley (with Clover), 2 cwts. superphosphate, 2 cwts. Nitrate Soda.	**Barley** (¾), 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda. **Tares** (¼), Dung.	**Barley.** (¾) 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda, (¼) 2½ cwts. Nit. Soda alone.	**Roots** (½), 25 tons Dung, 1 cwt. Nitrate Soda (Carted off); **Fallow** (½).	**Wheat,** 50 bushels Soot.	**Mangolds,** Dung 20 tons.	25	Sawyers'.
Oats, 2 cwts. superphosphate, (⅔) 1½ Nitrate Soda, (⅓) 2½ Nitrate Soda.	**Fallow.**	**Wheat,** 2 cwts. Nitrate Soda.	**Winter Oats,** 2 cwts. Nitrate Soda.	**Barley,** 50 bushels Soot.	**Barley,** 2½ cwts. superphosphate, 2½ cwts. Nitrate Soda.	30	West Barn.

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